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ABSTRACT

This curriculum guide provides instructional materials to assist in training equipment operators in the safe and effective use of highway maintenance equipment. It includes 18 units of instruction covering the large equipment used in maintenance operations. Each unit of instruction consists of eight basic components: performance objectives, teacher activities, information sheets (content essential for meeting the cognitive objectives), assignment sheets (applications of knowledges that are prerequisites to skill development), job sheets (procedures to complete a manipulative or psychomotor skill), transparency masters, tests, and test and assignment sheet answers. Eighteen pieces of equipment are included: motor graders, asphalt distributor, rollers, dozer, backhoe, cranes and attachments, cherry picker (aerial bucket truck), spreader (self-propelled), mud jack, asphalt laydown machine, asphalt recycling machines, bridge snooper, snow blower, striping and painting equipment, pugmill, vacuum sweepers, crack-sealing equipment, and rigging. For each piece of equipment, this manual covers uses in highway maintenance, controls, attachments, procedures for effective operation, inspection and service, basic operating procedures, typical maintenance operations, and safety procedures. The materials are suitable for students who are new employees, seasoned operators upgrading skills, or skilled operators reviewing procedures and using these materials for reference. (YLB)

ED240322

Highway Maintenance Equipment Operator

Specialized Equipment

TRAINING MATERIALS

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HIGHWAY MAINTENANCE EQUIPMENT OPERATOR

SPECIALIZED EQUIPMENT

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FOREWORD

In 1981, as an effort to provide high-quality and uniform training materials, the Departments of Transportation in Oklahoma and Kansas and the New Mexico Highway Department entered into an agreement with the Oklahoma State Department of Vocational and Technical Education, Curriculum and Instructional Materials Center, to develop a curriculum for equipment operators in highway maintenance. *Highway Maintenance Equipment Operator: Specialized Equipment* is the second of three books printed as a result of the cooperative effort.

Within this consortium, administrators, supervisors, operators, and writers collaborated closely to produce materials that will provide each student with information and practical learning experiences directly applicable to maintenance operations. Whether the students are new employees, seasoned operators upgrading skills, or skilled operators reviewing procedures and using these materials for reference, they can appreciate the expertise of the people who created *Highway Maintenance Equipment Operator.*

The information in *Highway Maintenance Equipment Operator: Specialized Equipment* has been selected to apply generally to highway maintenance training programs, and should be adapted and modified to coincide with departmental policy, specifications, and objectives.

It is my sincere hope that *Highway Maintenance Equipment Operator* will contribute to the development of a competent, safety-conscious work force in maintenance operations across the country. Also, I hope that the dedication and active interest repeatedly shown by highway department representatives and employees carries through this publication from teacher to student and, through craftsmanship and care, to the highway-traveling public.

Francis Tuttle, Director
Oklahoma State Department of
Vocational Education

PREFACE

This curriculum was designed and prepared especially for equipment operators in highway maintenance. From gravel roads to multilane urban interstates, it is the responsibility of maintenance teams to maintain the roadways and rights-of-way in a condition safe for public and commercial use. Therefore, the purpose of these materials is to assist in training those teams in the safe and effective use of maintenance equipment.

Highway Maintenance Equipment Operator: Specialized Equipment includes the larger equipment used in maintenance operations, from multipurpose equipment such as graders to highly specialized equipment such as bridge snoopers. For each piece of equipment, this manual covers uses in highway maintenance, controls, attachments, procedures for effective operation, inspection and service, basic operating procedures, typical maintenance operations, and safety procedures.

Safety cannot be too strongly stressed. We have made every effort to ingrain a safety-conscious attitude as the operator's first and foremost responsibility. Departmental safety manuals should be provided for each student and should be incorporated into the teaching of each unit.

We realize that departmental policy and available materials will vary with each training program, and we urge you to make whatever modifications are necessary and desirable to meet your own circumstances and objectives.

For the instructor, *Highway Maintenance Equipment Operator: Specialized Equipment* offers a systematic presentation of information, written and applied exercises, and evaluation procedures. It is not intended that the units in this manual stand alone, but that they be enhanced with additional materials and with the instructor's own methods, experience, and enthusiasm.

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It is with deep respect that I thank the employees of the Departments of Transportation in Kansas and Oklahoma for sharing their time and experience. They are skilled, dedicated, enthusiastic people who take pride in their work. It has been a pleasure and an honor to be associated with them.

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PRODUCTION STAFF

The production staff includes many people in Graphics Division word processing, art, and printing whose names I do not know, but whose work I recognize and appreciate.

The fine talented hands of Regina Beaney, Dana Welborne, and Carrie Williams prepared the artwork for this project; Joan Henderson was the photographer; Claire Dickey and Jim Thomas processed film and photos.

Many thanks to Terra McCluskey and her editing staff, who have polished and finished my rough work. My time with them has been enjoyable and instructive. Thank you, Lynne Murnane, Susan Walker, Terri Perry, Jerry Weir, Sue Buck, Barbi Harrison, and Marla Hamilton.

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And to you who are learning or upgrading your skills in highway maintenance, a sincere and special thanks. Few people have the opportunity I have had to know how important and demanding your work is. I am happy and grateful that I can contribute to your safety and growth.

Sandra D. Perky, Curriculum Writer
Curriculum and Instructional Materials Center

USE OF THIS PUBLICATION

Instructional Units

Highway Maintenance Equipment Operator: Specialized Equipment includes eighteen units of instruction. The format used by the Oklahoma CIMC includes eight basic components, which form a unit: performance objectives, suggested activities for the teacher, information sheets, assignment sheets, job sheets, transparency masters, tests, and answers to tests and assignment sheets. Depending on the specific objectives, there may or may not be transparency masters, assignment sheets, or job sheets included in the unit of instruction.

All of the unit components "zero in" on measurable and observable learning outcomes. Teachers are encouraged to supplement, personalize, localize, and motivate with these materials in order to develop a complete teaching/learning process.

Units of instruction are designed for use in more than one lesson or class period of instruction. Careful study of each unit of instruction by the teacher will help him or her determine the following

A. Amount of material that can be covered in each class period
B. Skills that must be demonstrated
    1. Supplies and equipment needed
    2. Amount of practice needed
    3. Amount of class time needed for demonstrations
C. Supplementary materials, such as pamphlets and filmstrips, that must be ordered
D. Resource people who must be contacted

Performance Objectives (white pages)

Each unit of instruction is based on the performance needed for safe and effective equipment operation. Performance objectives are stated in two forms: unit objectives, stating the subject matter to be covered in a unit of instruction; and specific objectives, stating the student performance necessary to reach the unit objective.

Since the objectives of the unit provide direction for the teaching/learning process, it is important that teachers and students have a common understanding of the intent of the objectives. Following is a list of performance terms, their meanings, and behavioral synonyms that may have been used in this material.

A. Name--The individual supplies a name for objects, events, or people

Behavioral synonyms: Label, list, letter, record, reiterate, repeat, write

B. Identify--The individual selects a named, described, or pictured object by pointing to it, touching it, picking it up, or selecting it

Behavioral synonyms: Select, mark, match, choose, judge

C. State a rule--The individual communicates a relationship or principle that could be used to solve problems or perform a task

D. Apply a rule--The individual supplies an answer to a problem by using a stated relationship or principle

Behavioral synonyms: Solve, calculate

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E. Describe--The individual relates sufficient characteristics or properties of an object or event so that a second individual will be able to state what is being discussed

Behavioral synonyms: Define, discuss, interpret, recite, tell how, tell what happens when

F. Distinguish--The individual selects an object or event from two or more that are easily confused

Behavioral synonyms: Discriminate, differentiate

G. Order--The individual arranges three or more objects or events in a sequence based on a stated property

Behavioral synonyms: Arrange, sequence, list in order, classify, divide, isolate, sort

H. Construct--The individual makes a physical object, a verbal statement, or a drawing

(NOTE: *Construct* is used when the finished product or result is important.)

Behavioral synonyms: Draw, make, build, design, formulate, reproduce, transcribe, convert, put together, compile

I. Demonstrate--The individual performs several operations necessary to carry out a specified process

(NOTE: *Demonstrate* is used when it is desirable to watch the student perform a task, one of the highest levels of student performance.)

Behavioral synonyms: Show your work, show procedure, perform an experiment, perform the steps, operate, remove, replace, turn off/on, (dis) assemble, (dis) connect

The objectives should be provided for students and stressed throughout the teaching/learning process. This will help answer any questions concerning performance requirements for each instructional unit. The objectives can also help determine teaching strategies and instructional methods. Prepare for each unit by deciding how each objective can best be taught in accordance with your own methods and experience.

The objective sheet may be also used as a quick pretest to determine prior knowledge of students and to determine whether further study or activities are necessary. Teachers should feel free to modify, delete, or add objectives in order to meet the needs of the students and department. When changes in objectives are made, the teacher should remember to supply the needed information, assignment and/or job sheets, and criterion test items.

Suggested Activities (pink pages)

This component is included only in teacher material. The suggested activities page assists teachers during the preparation stage of the teaching/learning process by providing suggestions for delivery and/or presentation during the instructional process. Read the suggested activities before teaching the units so that supplemental materials can be obtained, audiovisual materials prepared, and outside resources contacted. Duties of the teacher will vary according to the particular unit.

The references that are listed are ones used in the development of each unit. They should be used by the teacher to supplement knowledge of the subject area or to help students with particular interests or occupational objectives in the area covered.

Information Sheet (green pages)

The information sheet provides "must know" content essential for meeting the cognitive (knowledge level) objectives of the unit. The information is written in a topical outline form and is keyed to the specific objectives.

Teachers will find that the information sheet serves as an excellent guide for presenting background knowledge necessary to develop the skills specified in the unit objective. The information sheet may also be used for coordination activities and advisory committees.

Students should read the information sheet before the information is discussed in class. Space is provided in margins for students and teachers to add notes that supplement, localize, personalize, or provide motivation for each unit.

Transparency Masters (white pages in teacher material and green in student material)

Transparency masters provide information in a special way. Transparencies direct the class' attention to the topic of discussion. Transparencies may present new information, or they may reinforce information presented in the information sheet. They are particularly effective when identification is necessary. Transparencies should be made and placed in the notebook where they will be immediately available for use.

Assignment Sheets (brown pages)

Assignment sheets give students a chance at problem solving, self-assessment, and/or practical experience with the information. They assist students in the application of knowledges that are necessary prerequisites to skill development. These may be given to the student for completion in class or used for homework assignments. Answer sheets are provided, when appropriate, and can be used by the student and/or teacher for checking student progress.

Job Sheets (blue pages)

Job sheets are another important segment of a unit of instruction. The job sheets provide a list of equipment, tools, and materials needed to complete a manipulative or psychomotor skill. They describe a step-by-step procedure needed to complete each task or job. Diagrams, photographs, and illustrations are provided to assist students in achieving the skill.

A teacher should demonstrate to students the procedures outlined in each job sheet. Furthermore, the teacher needs to localize the job sheet according to the equipment and supplies available in the local situation. Job sheets also furnish potential employers with a picture of the skills being taught and the performances they might reasonably expect from a person who has had this vocational instruction.

Test (yellow pages)

This component provides criterion-referenced evaluation of every objective listed in the unit of instruction. It is crucial to note that both paper/pencil and performance objectives must be evaluated.

The tests may be written or oral. It is recommended that the tests be divided into shorter tests covering three or four objectives at a time and given soon after those objectives have been covered. A selection of questions from the units covered may be used for final tests at the end of each term if desired. If objectives have been added, deleted, or modified, be sure to make the changes on the test.

The acceptable response on a unit test--eighty-five percent in most units--may be raised or lowered to fit the topic or students' ability levels. The percentage applies to the overall score, not to each question. The final grade should be obtained by using the paper/ pencil score along with teacher evaluations of student demonstrations of the desired skills.

Answers to Test and Assignment Sheets (pink pages)

These components are designed to assist the teacher in evaluation of student performances.

Page Numbering

Each publication from the Curriculum and Instructional Materials Center is assigned a specific abbreviation. For example, *Highway Maintenance Equipment Operator: Specialized Equipment* has been abbreviated DOT II. The units are then numbered consecutively. An example of a page number is DOT II - 1. Because CIMC publications are loose leaf, this system of page numbering was adopted so that pages from different manuals would not get mixed up.

Method of Disseminating Material

Material may be given out a unit or page at a time to keep the material before the student always new. Some teachers ask students to furnish a three-ring binder for the current unit of study. This is more convenient for taking the material home to study. Upon completion, each unit is then placed in a larger binder. The large binders may be purchased at cost from the CIMC. Some teachers store the material by units in filing cabinets or boxes until needed. All the units may be given out at once if desired.

Student materials should be provided for each student for best results. Student materials contain everything but the test answers, answers to assignment sheets, and suggested activities. The tests are collated at the back of student material and should be removed and stored until needed. Students should be allowed to take their materials home at the end of the year.

Teaching Methods

It is a challenge to keep students motivated. Supplement the objectives by providing the "why," personal experiences, and current information. Prepare for each unit by deciding how each objective can best be taught. Allow students to become involved in preparing and planning.

MOTOR GRADERS
UNIT I

UNIT OBJECTIVE

After completing this unit, the student should be able to operate a motor grader safely and effectively to perform various jobs. This knowledge will be shown by completing the job sheets and unit test with a minimum score of 85 percent.

SPECIFIC OBJECTIVES

After completing this unit, the student should be able to

1. Match terms associated with motor graders to their correct definitions.
2. List uses of a motor grader.
3. Select from a list types of highway-maintenance jobs done with motor graders.
4. Identify basic parts of a motor grader.
5. Identify typical motor grader controls.
6. Match motor grader controls to their correct functions.
7. Match motor grader accessories to their correct uses.
8. State general safety rules for operating equipment.
9. State safety rules for operating a motor grader.
10. Select from a list principles of moldboard operation.
11. Match specific conditions to correct techniques of motor grader operation.
12. Distinguish among straight-mode, articulated-mode, and crab-mode techniques for operating an articulated motor grader.
13. Select from a list procedures for effective motor grader operation.
14. Match windrow and pile placement to their correct operations.
15. Select from a list principles of scarifier operation.
16. Demonstrate the ability to
    a. Perform prestart inspection and maintenance procedures on a motor grader.
    b. Service a motor grader.
    c. Start, operate, shut down, and secure a motor grader.
    d. Operate an articulated motor grader.

OBJECTIVE SHEET

e. Change the blade on a motor grader.

f. Turn a motor grader around.

g. Make a windrow.

h. Cut a firebreak.

i. Remove snow.

j. Blend and spread material on a roadbed.

k. Grade an unpaved road.

l. Perform V-type ditch construction.

m. Scarify a section of asphalt road.

MOTOR GRADERS
UNIT I

SUGGESTED ACTIVITIES

I. Suggested activities

A. Order films and other materials planned to supplement unit.

1. Sales-training video tape recordings

(NOTE: These video tape sales-training recordings from John Deere are suitable for showing to students.)

a. *Modern Motor Grader Operation.* Color, 25 minutes, Deere and Company, n.d. Available from Deere and Company, Distribution Service Center, 1400 Third Avenue, Moline, Illinois 61265, Order No. VTR-175109.

(NOTE: This video tape recording acquaints potential operators with hydraulic functions and trains them in the operational techniques of articulated motor graders.)

b. *All-Wheel Drive: Sure-Footed Solution to Snow Removal.* Color, 6 minutes, Deere and Company, n.d. Available from Deere and Company, Distribution Service Center, 1400 Third Avenue, Moline, Illinois 61265, Order No. VTR-180601.

(NOTE: This video tape recording is oriented toward selling John Deere all-wheel-drive motor graders, but does demonstrate V-plow and snow-wing applications.)

2. Films

a. *Your Body Is Only Human.* Color, 10 minutes, National Safety Council, n.d. Available from National Safety Council, 444 North Michigan, Chicago, Illinois 60611, 312/527-4800.

(NOTE: This film shows the relationship between body and mind in establishing safe work patterns. Man's physical limits are explored.)

b. *Operating Tips: Motor Graders.* 18 minutes, Caterpillar, n.d. Available from Caterpillar Film Library, Modern Talking Picture Service, Inc., 1867 Elmhurst Road, Elk Grove Village, Illinois 60007, 312/593-3250. Request "Operating Tips: Motor Graders No. 30822."

(NOTE: An experienced operator/demonstrator explains the basic responsibilities that go along with operating a motor grader.)

SUGGESTED ACTIVITIES

3. Video-cassette programs

   a. *Save That Road, Part 1.* Color, 20 minutes, Oklahoma State University, 1979. Available from Oklahoma Department of Transportation, Training Office, 200 N.E. 21st, Oklahoma City, Oklahoma 73105, 405/521-4141. Request "Code No. 425-79-1-1."

   (NOTE: Part 1 demonstrates machine-patching cutout failures, illustrates the various types of failures that occur routinely in asphalt road surfaces, and concerns itself with proper systematic methods of deep-failure repair operations. The program also includes equipment and personnel requirements, recommended safety, failure-marking practices, and a step-by-step procedure of the repair of various deep-failure situations with heavy machinery.)

   b. *Save That Road, Part 2.* Color, 22 minutes, Oklahoma State University, 1979. Available from Oklahoma Department of Transportation, Training Office, 200 N.E. 21st, Oklahoma City, Oklahoma 73105, 405/521-4141. Request "Code No. 425-79-1-1."

   (NOTE: Part 2 illustrates surface-failure conditions that do not require the total removal of the existing pavement, traces the established procedures of properly blade-laying surface patches to restore contour and rideability of the roadway, and includes techniques on paving one side and both sides of the highway.)

4. Slide-cassette presentation--*The Winning Combination,* 64 slides, Galion/Dresser, n.d. Available from Sales Products Support Group, The Learning Center, Galion Manufacturing Division, P.O. Box 647, Galion, Ohio 43833, 419/468-4321.

   (NOTE: This is a presentation for distributor merchandising, but it is suitable for student viewing. It details features and benefits of the motor grader, and includes shots of the motor grader in fine grading, ditching, bank-sloping, cul-de-sac, and many other applications. *The Winning Combination* is also available as a 14 1/2-minute film, but the slide presentation allows the instructor to stop and make comments or answer questions. A printed script is included with the slides and cassette.)

B. Provide students with objective sheet.

C. Provide students with information and job sheets.

D. Discuss unit and specific objectives.

E. Discuss information sheet.

SUGGESTED ACTIVITIES

F. Demonstrate and discuss procedures outlined in job sheets.

G. Invite a resource person to speak on motor grader operations.

H. Invite a resource person to speak on motor grader safety.

I. Arrange to visit a maintenance yard to inspect and see a demonstration of a motor grader.

J. Build a working model of the circle and moldboard to demonstrate reverse blading and angle, height, and pitch adjustments.

K. Arrange a field trip to watch a grading operation.

L. Discuss road materials and snow conditions as they relate to motor grader operation requirements.

M. Give test.

II. Instructional materials

A. Objective sheet

B. Suggested activities

C. Information sheet

D. Job sheets

1. Job Sheet #1--Perform Prestart Inspection and Maintenance Procedures on a Motor Grader
2. Job Sheet #2--Service a Motor Grader
3. Job Sheet #3-Start, Operate, Shut Down, and Secure a Motor Grader
4. Job Sheet #4--Operate an Articulated Motor Grader
5. Job Sheet #5--Change the Blade on a Motor Grader
6. Job Sheet #6--Turn a Motor Grader Around
7. Job Sheet #7--Make a Windrow
8. Job Sheet #8--Cut a Firebreak
9. Job Sheet #9--Remove Snow
10. Job Sheet #10--Blend and Spread Material on a Roadbed
11. Job Sheet #11--Grade an Unpaved Road

SUGGESTED ACTIVITIES

12. Job Sheet #12--Perform V-Type Ditch Construction
13. Job Sheet #13--Scarify a Section of Asphalt Road

E. Test

F. Answers to test

III. Unit references

A. *Equipment Operator 3 & 2 Training Manual.* Naval Training Command. Washington, D.C.: U.S. Government Printing Office, 1973.

B. Nichols, H. L., Jr. *Moving the Earth,* 3rd ed. Greenwich, Connecticut: North Castle Books, 1976.

C. *Operator's Guide, Series G Motor Graders.* Peoria, Illinois: Caterpillar Tractor Company, 1979.

D. *Operator's Manual John Deere JD770-A and JD772-A Motor Graders.* Moline, Illinois: Deere and Company, n.d.

E. *Operator's Manual No. 3950 R1, Model A550 Motor Grader.* Galion, Ohio: Galion Manufacturing Division, Dresser Industries, Inc., n.d.

F. *Teacher's Guide: Heavy Equipment Operator Training, Unit II, Motor Grader Operation.* College Station, Texas: Engineering Extension Service, Texas A & M University, n.d.

MOTOR GRADERS
UNIT I

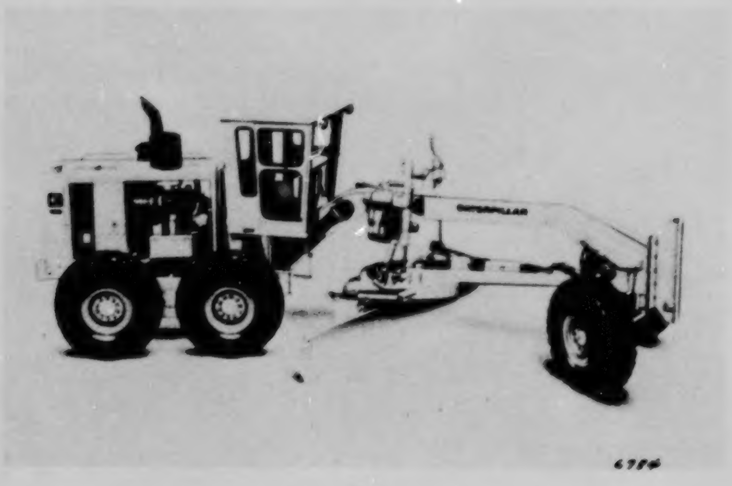
INFORMATION SHEET

I. Terms and definitions

A. Motor grader--Machine with centrally located blade that can be angled to cast to either side; may be rigid frame or articulated frame (Figure 1); has independent hoist control on each side

EXAMPLE: Articulated Frame

FIGURE 1



Courtesy of Caterpillar Tractor Company.

B. Articulated--Jointed

(NOTE: On a motor grader, the front module is joined to a movable rear module.)

C. Accessories--Attachments used to increase a machine's versatility and effectiveness

D. Scarify--To loosen the road surface

E. Windrow--Ridge of loose material

F. Blue tops--Hub stakes used during final grading process when existing grade is within 0.2 foot of desired grade

G. Keel--Colored marking crayon used to mark tops of blue-top stakes

H. Blend--To mix materials until they are uniform

I. Firebreak--Area cleared of combustible materials

INFORMATION SHEET

J. Sidecasting--Pushing load drifts to trailing end of blade

K. Crown--To build up middle of roadbed so that water will flow to sides

L. Toe--Leading end of motor grader blade

M. Heel--Trailing end of motor grader blade

II. Uses of a motor grader

(NOTE: The motor grader is probably the most versatile piece of heavy equipment used in highway maintenance, and a skilled motor grader operator is the artist of the crew. The major advantage of a motor grader is that it casts material to the side, rather than straight ahead as does a dozer. The blade can be moved up and down and can be adjusted for height, angle, pitch, and reverse direction.)

A. Cutting

B. Shaping

C. Earth moving

D. Spreading

E. Fine grading

F. Snow and ice control

III. Types of highway-maintenance jobs done with motor graders (Job Sheets #7-#12)

A. Leveling

B. Scarifying or ripping

C. V-type ditch construction

D. Bank sloping

E. Flat-bottom ditch cutting

F. Reverse blading

G. Mixing and spreading materials

H. Snow removal

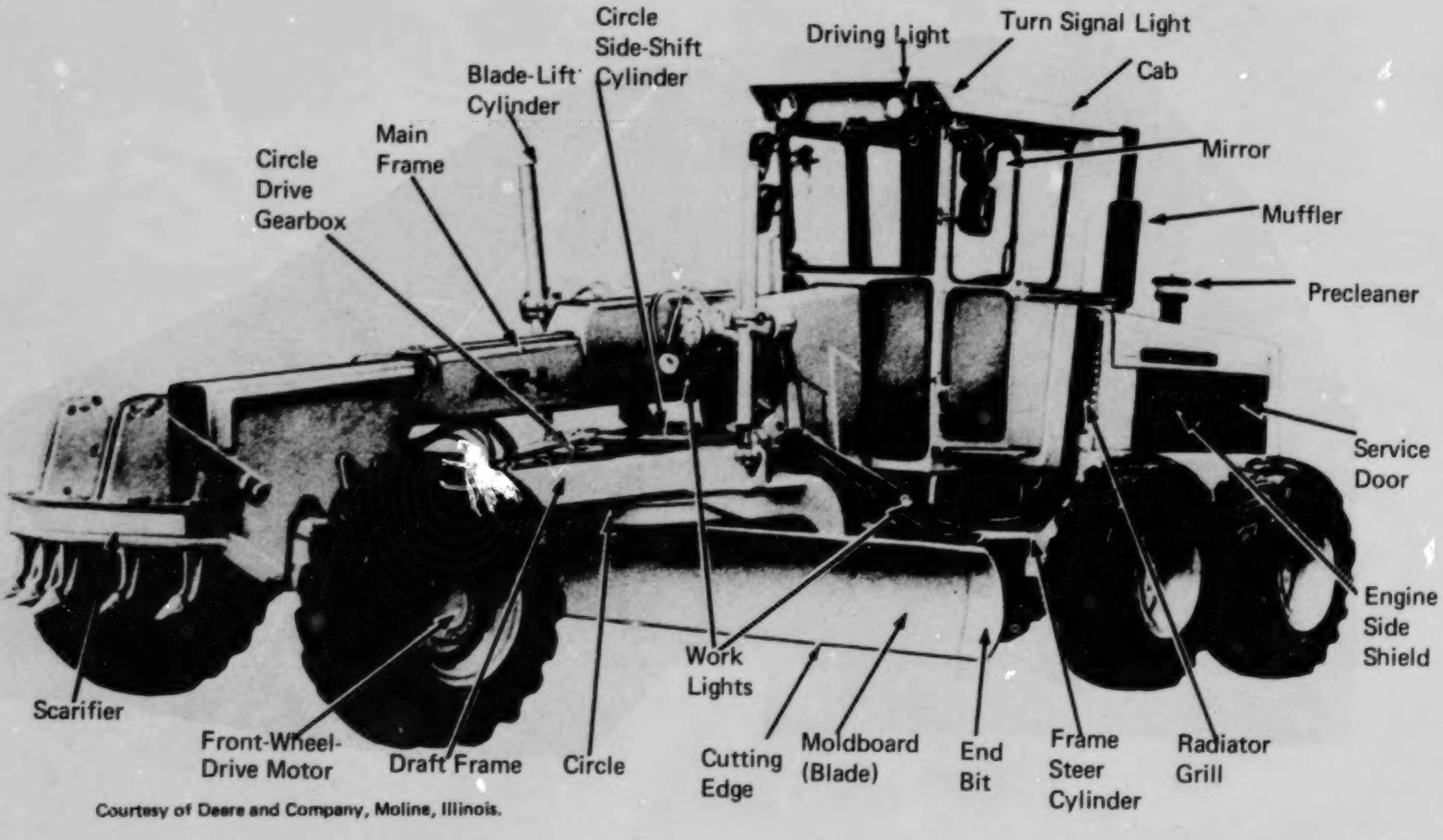
I. Finish grading

J. Road maintenance

INFORMATION SHEET

IV. Basic parts of a motor grader (Figure 2; Job Sheet #2)

FIGURE 2


Circle Side-Shift Cylinder
Driving Light
Turn Signal Light
Cab
Blade-Lift Cylinder
Main Frame
Circle Drive Gearbox
Mirror
Muffler
Precleaner
Service Door
Engine Side Shield
Scarifier
Front-Wheel-Drive Motor
Draft Frame
Circle
Work Lights
Cutting Edge
Moldboard (Blade)
End Bit
Frame Steer Cylinder
Radiator Grill

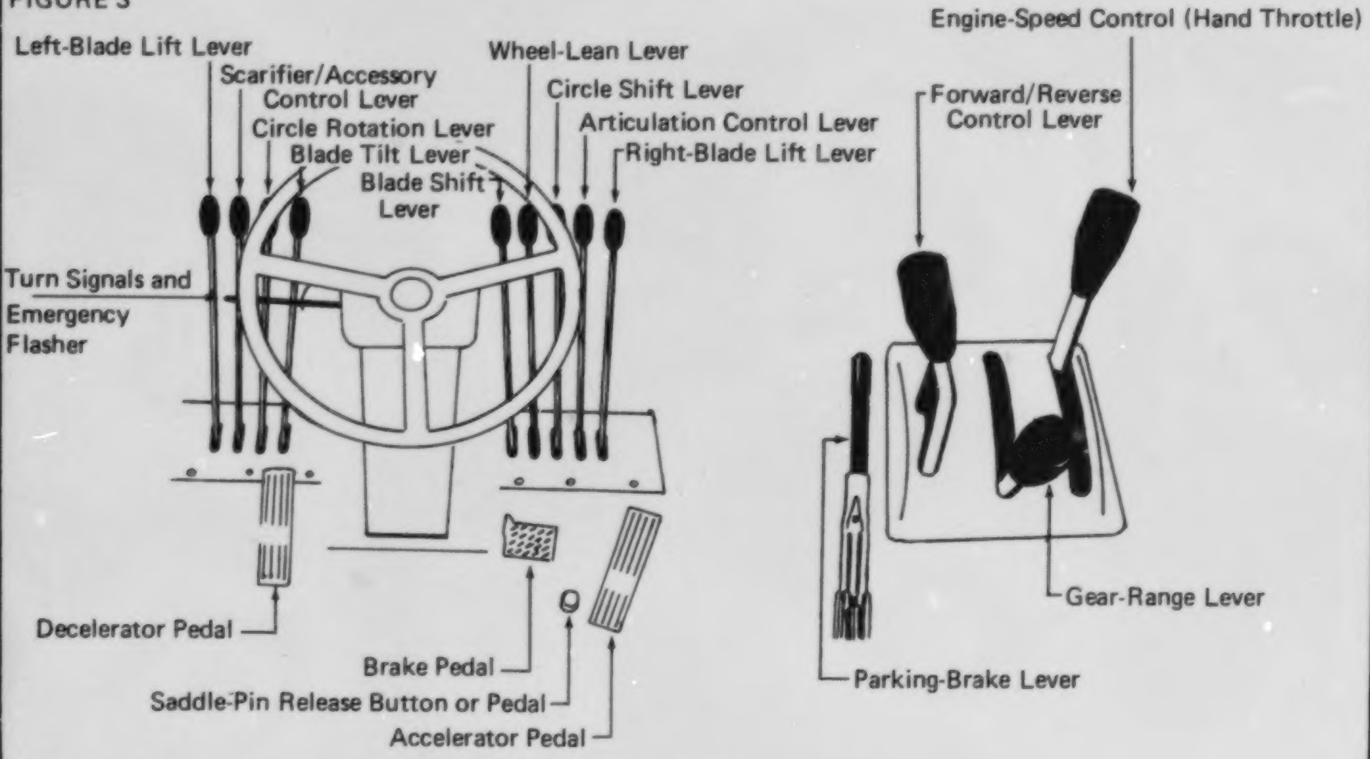
Courtesy of Deere and Company, Moline, Illinois.

INFORMATION SHEET

Typical motor grader controls (Figures 3 and 4)

(NOTE: Location of controls will vary with manufacturer and model. Check operator's manual. Figure 3 does not apply to John Deere motor graders equipped with hydrostatic drive. See Figure 4 on the following page.)

FIGURE 3



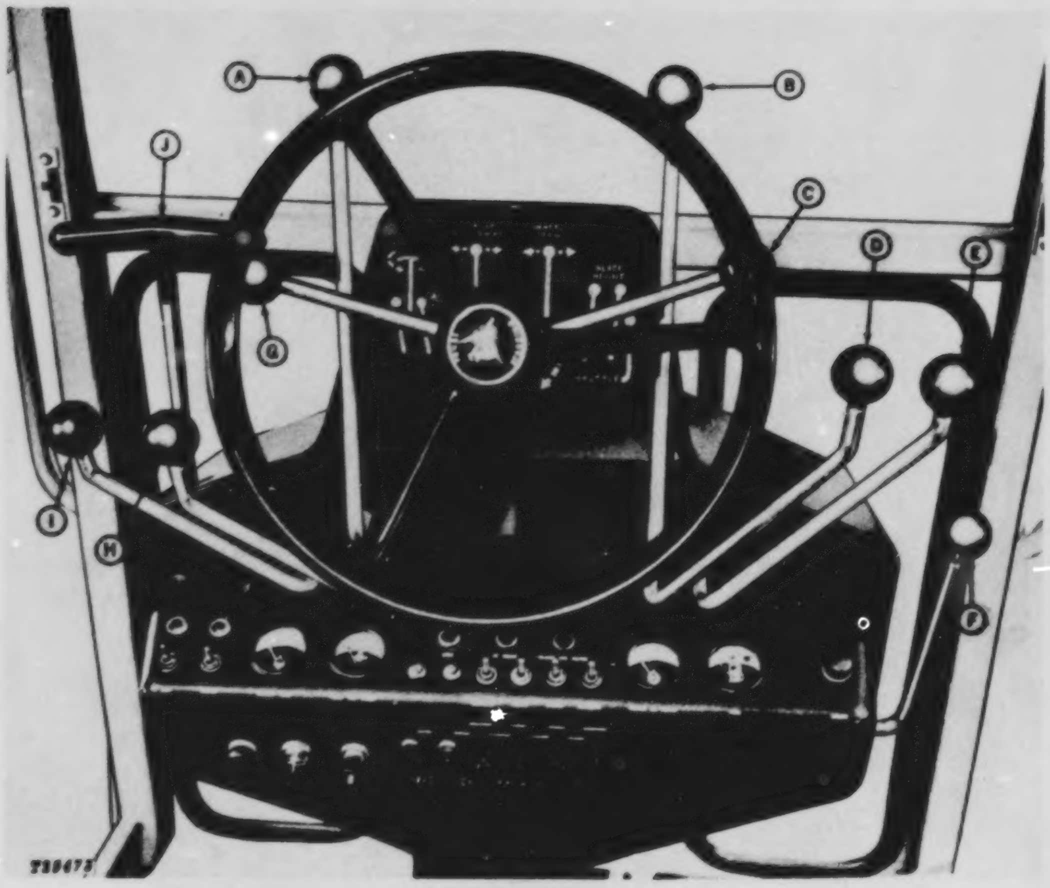
Left-Blade Lift Lever
Scarifier/Accessory Control Lever
Circle Rotation Lever
Blade Tilt Lever
Blade Shift Lever
Wheel-Lean Lever
Circle Shift Lever
Articulation Control Lever
Right-Blade Lift Lever
Engine-Speed Control (Hand Throttle)
Forward/Reverse Control Lever
Turn Signals and Emergency Flasher
Gear-Range Lever
Decelerator Pedal
Brake Pedal
Saddle-Pin Release Button or Pedal
Accelerator Pedal
Parking-Brake Lever

Adapted with permission of Galion Manufacturing Division, Dresser Industries, Inc., Galion, Ohio.

INFORMATION SHEET

EXAMPLE: Controls on a John Deere motor grader with hydrostatic drive

FIGURE 4



Courtesy of Deere and Company, Moline, Illinois.

A. Circle side-shift lever

B. Wheel-lean lever

C. Right frame-steer lever

D. Left blade-lift lever

E. Right blade-lift lever

F. Hand throttle

G. Left frame-steer lever

H. Blade pitch lever

I. Auxiliary lever

J. Circle rotation and blade side-shift lever

INFORMATION SHEET

VI. Functions of motor grader controls (Job Sheets #3-#5)

A. Left blade-lift lever--Raises and lowers left end of blade

B. Right blade-lift lever--Raises and lowers right end of blade

(NOTE: Blade-lift levers are usually located to the outside or outsides of the control-lever panel. They may be operated one at a time, or both levers together will raise or lower the entire blade.)

C. Circle shift lever--Moves circle to right or left

D. Circle rotation lever--Moves circle clockwise or counterclockwise

E. Scarifier/accessory control lever--Raises or lowers scarifier

F. Articulation control lever--Moves rear module from center to right or left

G. Blade shift lever--Moves moldboard to right or left

H. Blade tilt lever--Moves blade rearward or forward

I. Wheel-lean lever--Tilts front wheels to right or left

J. Forward/reverse control lever--Moves motor grader forward or rearward

(NOTE: The midpoint of the lever travel is neutral.)

K. Gear-range lever (transmission control)--Selects gear range

L. Engine-speed control (hand throttle)--Governs engine speed

M. Parking-brake lever--Secures motor grader when stopped or parked

N. Brake pedal--Stops or slows machine

(NOTE: Some models have right and left brake pedals that assist in turning.)

O. Accelerator pedal--Increases speed quickly

(NOTE: When accelerator is released, engine speed will return to hand-throttle setting.)

P. Decelerator pedal--Decreases speed quickly

(NOTE: When decelerator pedal is released, engine speed will return to hand-throttle setting.)

Q. Saddle-pin release button or pedal--Hydraulically releases saddle pin for changing blade position

(NOTE: The saddle-pin release button must be engaged or disengaged when changing blade position.)

INFORMATION SHEET

R. Differential lock (not shown)--Controls wheel speeds

(NOTE: When the differential lock is locked, the speed of the wheels will be equal. When unlocked, the speed of the wheels will be different.)

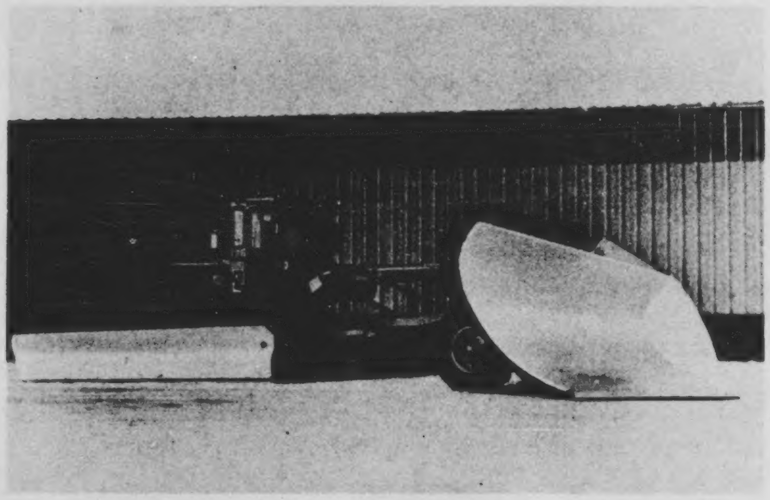
VII. Accessories used on motor graders

A. Snow plow (V-type)–Used to remove large drifts (Figure 5)

B. Side wing (snow wing)--Used to remove snow and cast it away from roadway

EXAMPLE: V-type snow plow with side wing (snow wing)

FIGURE 5



A. Side Wing (Snow Wing) B. V-Type Snow Plow

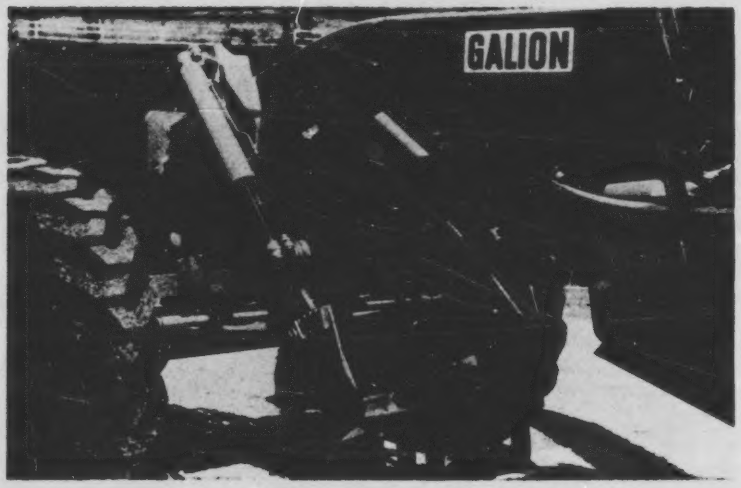
Courtesy of Little Falls Machine Inc., Little Falls, Minnesota.

INFORMATION SHEET

C. Scarifier (or scarifier/ripper)--Used for shallow loosening of road surface to be bladed (Figure 6)

EXAMPLE:

FIGURE 6

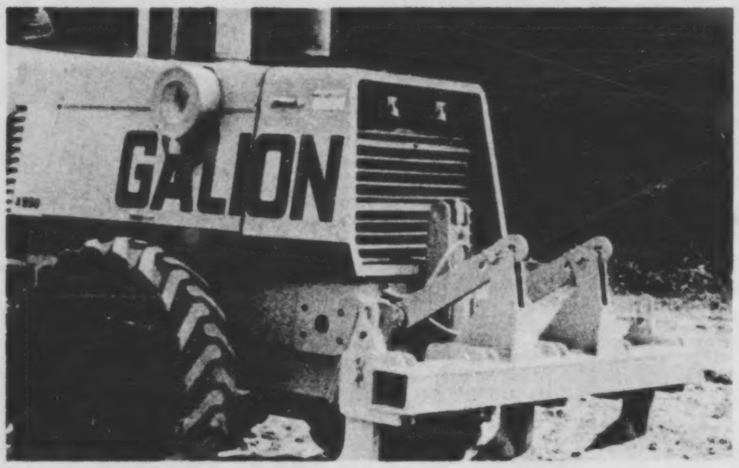


Courtesy of Galion Manufacturing Division, Dresser Industries, Inc., Galion, Ohio.

D. Ripper--Used to loosen hard soil and soft rock on road surface to be bladed (Figure 7)

EXAMPLE:

FIGURE 7



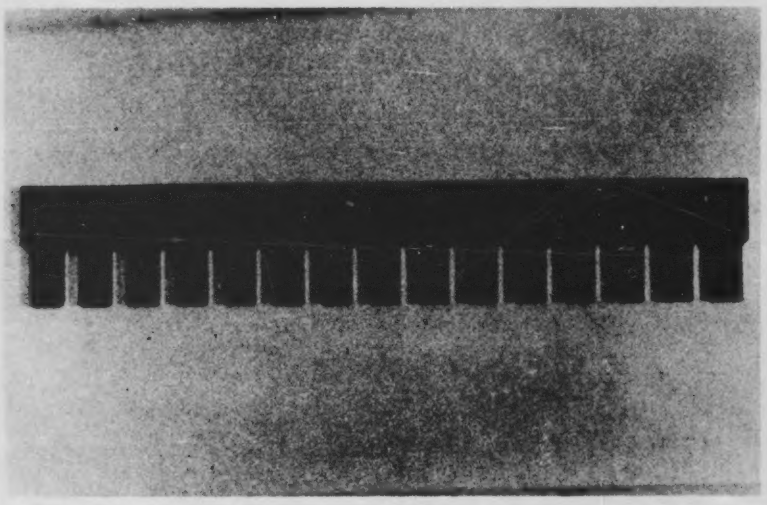
Courtesy of Galion Manufacturing Division, Dresser Industries, Inc., Galion, Ohio.

INFORMATION SHEET

E. Serrated blade–Used for laying asphalt material (Figure 8)

EXAMPLE:

FIGURE 8



Courtesy of Caterpillar Tractor Company.

VIII. General safety rules for operating equipment

(NOTE: Your safety and the safety of those around you are up to you.)

A. Wear safety items required by job conditions

B. Know and observe hand signals

C. Be sure all safety guards and covers are secure and in place

D. Do not operate machine until you are sure personnel and obstructions are cleared from area

E. Check all safety devices before moving machine

F. Do not jump on or off machine

G. Mount and dismount properly, using handholds and steps

H. Do not allow anyone to ride on machine

I. Know traffic pattern of job and obey spotter

J. Always park on level ground if possible

INFORMATION SHEET

K. Do not leave machine unattended while engine is running

L. Avoid operating too close to banks or overhangs

M. Watch for overhead electrical power lines

(CAUTION: Do not operate within 10 feet of power lines.)

(NOTE: Equipment does not have to come in direct contact with wires to act as a conductor. If operating near power lines, power to lines should be shut off, or lines should be insulated.)

N. Watch for flags indicating buried pipes and power and gas lines

(NOTE: Telephone and utility companies will flag the worksite with appropriately colored flags if necessary: gas and chemicals, *yellow*; phone, *orange*; electric, *red*; water, *blue*; sanitary and storm sewers, *green*.)

O. Keep equipment clean

IX. Safety rules for operating a motor grader

A. Read operator's manual thoroughly: know your machine

B. Do not start or operate motor grader unless you are in operator's station

C. Make a walk-around visual inspection to observe physical condition of machine before moving it

D. Drive carefully on hillsides and curves to avoid tipping

E. Reduce speed before turning or applying brakes

F. Use brake pedals together when traveling, and especially when making an emergency stop

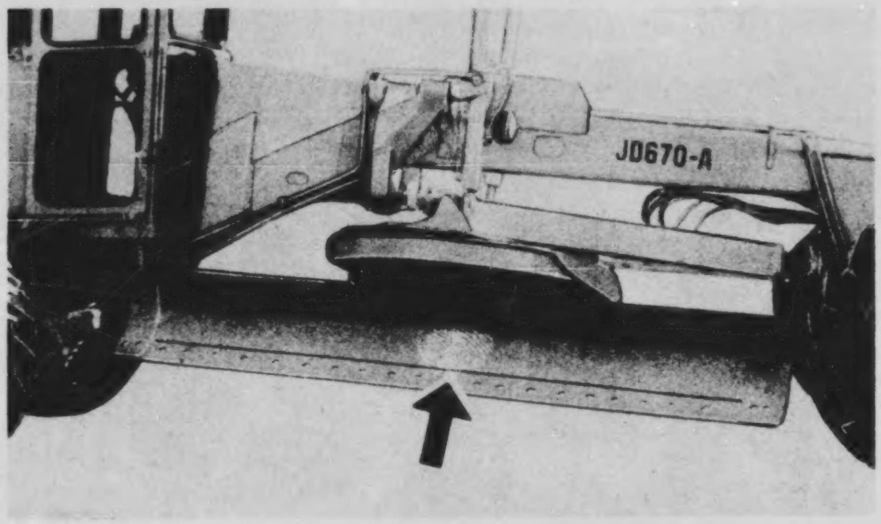
G. Drive at speeds slow enough to ensure your safety, especially over rough ground

INFORMATION SHEET

H. Travel with blade inboard of wheel tracks (Figure 9)

EXAMPLE:

FIGURE 9



Courtesy of Deere and Company, Moline, Illinois.

I. Lower blade to ground when securing or working on machine

J. Bring motor grader to a *complete stop* before shifting from a forward gear to a reverse gear, or from a reverse gear to a forward gear

K. Do not use motor grader or blade as a battering ram

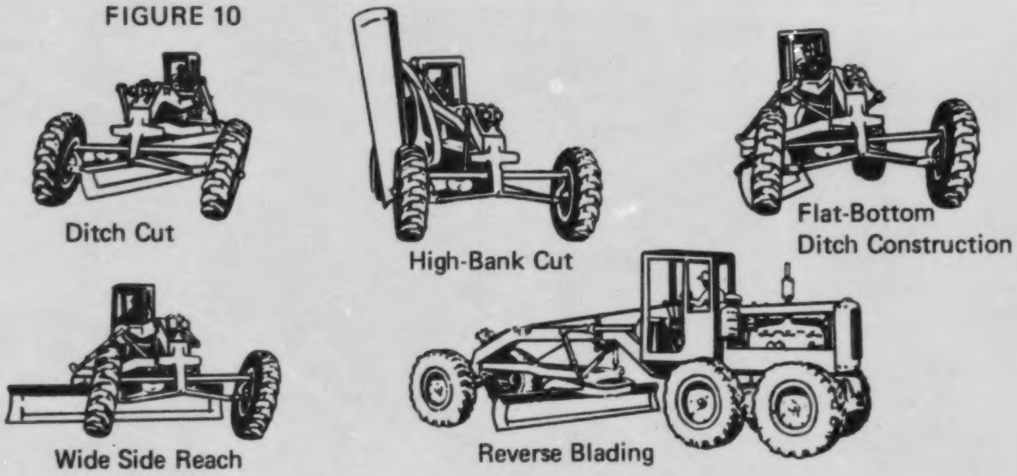
INFORMATION SHEET

X. Principles of moldboard operation (Figure 10; Job Sheets #7-#12)

(NOTE: A motor grader moldboard can be adjusted in a variety of ways. Actual adjustment depends upon the job and materials. The moldboard can be raised and lowered as little as a fraction of an inch to adjust to the grade being finished. It can be set at any angle and pitched forward or back. The circle can move left and right, or raise and lower the moldboard.)

EXAMPLES: Normal motor grader blade positions

FIGURE 10


Ditch Cut

High-Bank Cut

Flat-Bottom Ditch Construction

Wide Side Reach

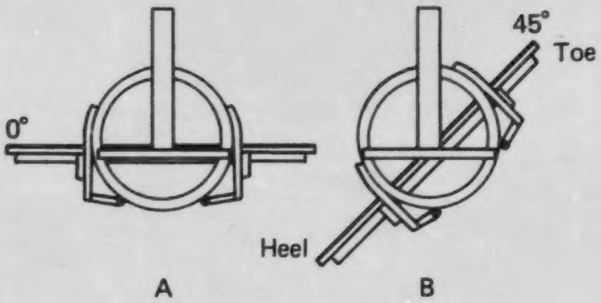
Reverse Blading

A. The greater the angle of the moldboard, the more earth will spill off the heel

B. As angle decreases, a greater amount of the load is drifted straight ahead

(NOTE: With the moldboard straight across the circle [0 degree], the effect is the same as bulldozing--pushing material straight ahead. See Figure 11.)

FIGURE 11



(A) Blade in 0-degree angle
(B) Blade in 45-degree angle

INFORMATION SHEET

C. Raising or lowering the blade determines depth of cut

D. Raising the blade determines whether material is cast into windrows or spread evenly

EXAMPLE: When heel of blade is raised, material will spill out underneath it and be spread along the surface by the forward motion of the moldboard. By lowering the moldboard, you can adjust it so that very little or none of the material will spill out under the blade. All material cut with the blade lowered will be spilled off the heel to form a windrow.

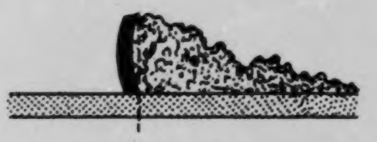
(NOTE: When one end of the blade is raised, the other end will be lowered, like a board balanced on a fulcrum. Raising the heel too far will drive the toe into the ground.)

E. Pitch adjustment produces a cutting or dragging action (Figures 12-15)

F. For normal grading operations, blade is kept near center of pitch adjustment so that tip of blade is directly over cutting edge

EXAMPLE:

FIGURE 12

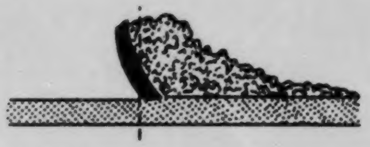


G. For greater cutting action, blade is pitched backward

(NOTE: Material will tend to roll up over blade.)

EXAMPLE:

FIGURE 13



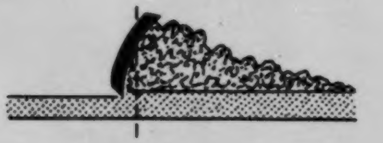
INFORMATION SHEET

H. For mixing and laying operations, blade is pitched slightly forward

(NOTE: This pitch is used for making light, rapid cuts because the cutting ability of the blade is decreased.)

EXAMPLE:

FIGURE 14

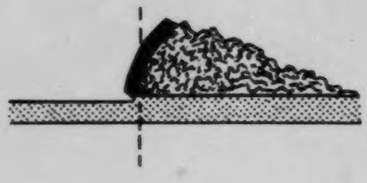


I. For spreading or maintaining surface material and for snow removal, blade is pitched farther forward

(NOTE: Blade will tend to ride over material rather than push it and will ride over obstructions.)

EXAMPLE:

FIGURE 15



INFORMATION SHEET

XI. Techniques of motor grader operation for specific conditions (Job Sheets #7-#12)

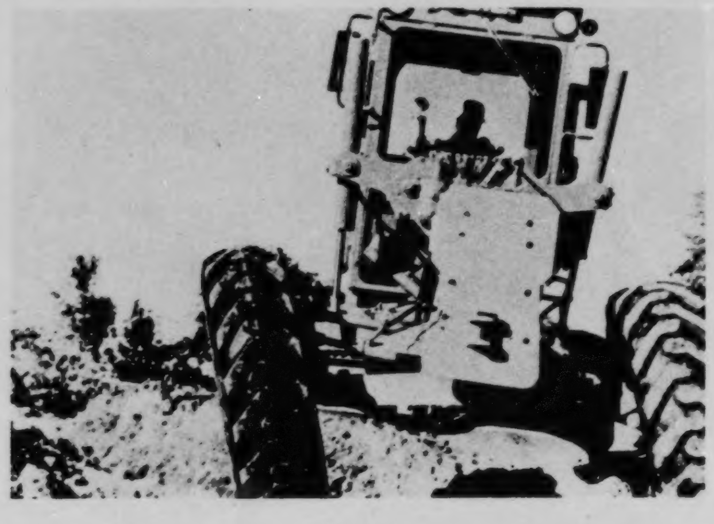
(NOTE: Proper use of the front wheels is a great aid in both steering and grading operations.)

A. Normal operations--Lean top of wheels away from direction of windrow (Figure 16)

(NOTE: If the moldboard is extended to the right side of the machine in moving a heavy cut or windrow to the left, a pulling force to the right is exerted on the front end of the machine. The top of the wheels should be leaned to the left to counteract this pulling force.)

EXAMPLE:

FIGURE 16



Courtesy of Champion Road Machinery International.

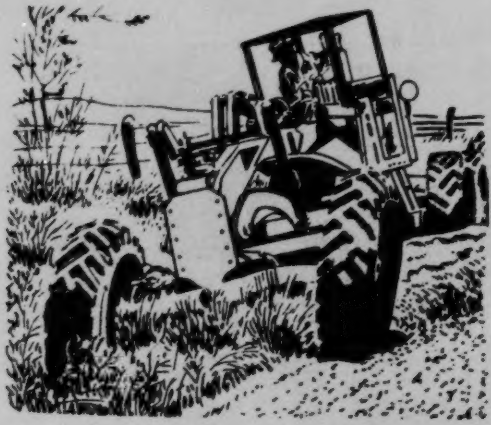
INFORMATION SHEET

B. Working on sloping side of a ditch--Lean top of front wheels enough to keep them in a vertical working position (Figure 17)

(NOTE: This wheel position will help keep the grader from drifting down the slope.)

EXAMPLE:

FIGURE 17

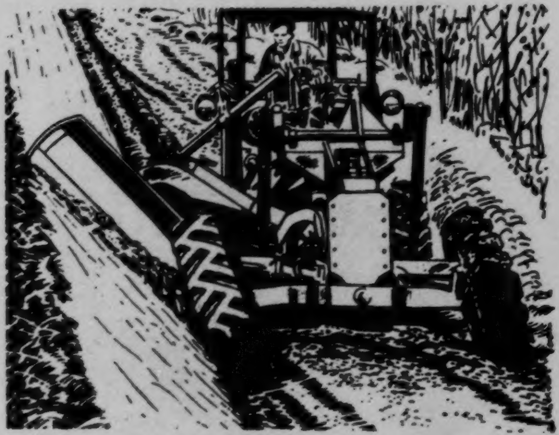


C. High bank-cutting operations--Lean top of wheels toward bank (Figure 18)

(NOTE: This wheel position keeps the blade properly positioned for bank sloping.)

EXAMPLE:

FIGURE 18



INFORMATION SHEET

D. Working around curves--Always lean top of front wheels in direction of turn (Figures 19 and 20)

EXAMPLES:

FIGURE 19

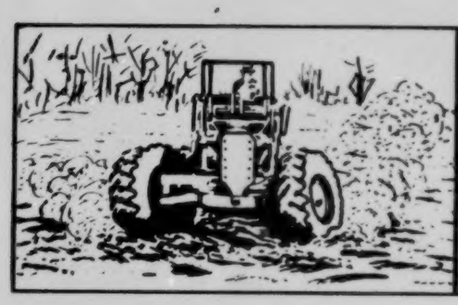
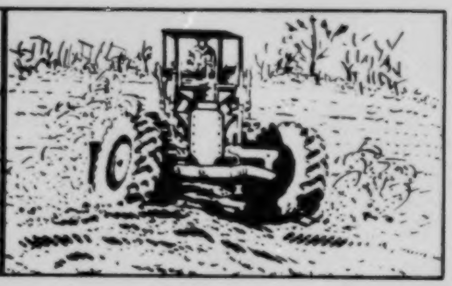


FIGURE 20

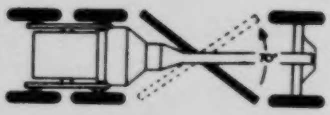


E. Jobs confined to short stretches or narrow widths--Change blade from forward to reverse grading position, a circle-reverse movement of about 70 degrees (Figure 21)

(NOTE: Operators usually make cutting passes in reverse, and then move the windrow over on the forward trips. This maneuver saves valuable time and speeds operations by eliminating frequent turning around of the motor grader.)

EXAMPLE:

FIGURE 21



F. Reverse blading--Be sure scarifier hang rods are shortened and scarifier teeth are removed

(NOTE: In all reverse work, leaning wheels are handled the same as in forward work.)

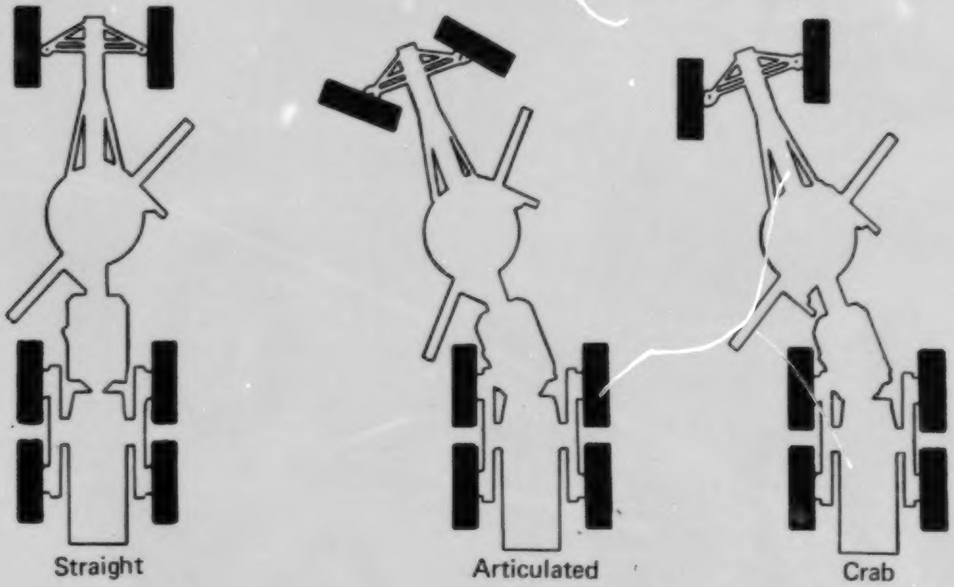
INFORMATION SHEET

XII. Techniques for operating an articulated motor grader (Figure 22; Job Sheets #4, #10, #11, and #12)

(NOTE: Articulated motor graders have greater application range and productivity than rigid-frame motor graders. Three operating modes--straight, articulated, and crab--may be used for efficient output in maintenance operations. In Figure 22 below, notice that in the crab mode, the motor grader is articulated and the front wheels are straight.)

EXAMPLES:

FIGURE 22



Used with permission of Public Works Magazine, Ridgewood, New Jersey.

A. Straight mode

1. Long-pass blading
2. Dry-ditch cleaning
3. Blading shoulders on paved roads
4. Scarifying

B. Articulated mode

1. Short turns
2. Blading shoulders on unpaved roads
3. V-ditch contruction
4. Spreading material

INFORMATION SHEET

5. Operating in tight areas

   (NOTE: Be careful the heel does not strike the rear tire.)

6. Cutting a high bank

   (NOTE: Articulation allows a higher reach on the bank than the reach that can be attained using the straight mode.)

C. Crab mode

1. Heavy windrowing operations
2. Wet-ditch cleaning
3. Smoothing washboards
4. Cutting a bank on a gentle slope (4:1)

   (NOTE: When cutting a bank on a gentle slope, crab steer so that the rear tandems run parallel with the slope on the downhill side. This provides greater stability than when blading with the frame straight.)

XIII. Procedures for effective motor grader operation (Job Sheets #1-#6)

A. Perform all prestart inspection and maintenance procedures

B. Do not work machine over capacity

C. Travel at highest practical travel speed that conditions will allow

(NOTE: Avoid excessive speed, particularly on rough ground.)

D. Use extreme care when turning on a downgrade

E. Service equipment regularly to ensure efficient operation

F. Keep equipment clean

G. Set as short a work cycle as possible

H. Plan operations before starting

I. Protect motor grader from dust and sand as much as possible

J. Inspect blade frequently during operation to prevent moldboard damage

K. When transporting motor grader, cover rain cap to protect turbocharger

(NOTE: Wind will turn blades and overheat turbocharger unit.)

INFORMATION SHEET

L. When front end tends to veer out of line, lean wheels in *opposite direction* enough to correct and hold machine in line (articulated motor grader only)

M. When rear module veers, move it in opposite direction enough to correct and hold machine in line (articulated motor grader only)

N. Always use decelerator or throttle to slow engine speed when shifting

(NOTE: Avoid excessive speed, particularly on rough ground.)

O. Operate each gear at full throttle

(NOTE: An exception is fine grading. For fine grading, operate at a lower throttle and in a higher gear.)

P. Use a lower gear when less speed is required

(NOTE: Normally, if the grader is operated too fast, it will have a tendency to bounce, giving the surface a washboard texture. Correction of this condition requires additional time and passes. Make sure that you are aware of this problem. If washboarding is not corrected, it will create unnecessary wear and tear on other equipment using the road or work area.)

XIV. Windrow and pile placement operations (Job Sheets #7 and #10)

(NOTE: When the toe is to your left as you sit in the driver's seat, the windrow will form off the heel to your right.)

A. Ditching--Keep windrow toward middle of road, away from ditching operation

B. Snow removal--Keep windrow toward shoulder

C. Dozing--Push pile straight ahead and spread

(NOTE: Where there is ample room, blade should be extended well to one side.)

D. Spreading--Spread and dump pile as much as possible

E. Leveling--Keep a partial load in front of blade to distribute it

XV. Principles of scarifier operation (Job Sheet #13)

(NOTE: A scarifier or scarifier/ripper is a motor grader attachment with a set of teeth used for breaking up surfaces too hard to be readily penetrated by the blade. It consists of a scarifier log with removable teeth and is permanently fixed to the machine. There are usually eleven teeth, each secured by a locking wedge. Pitch is adjustable for various operations.)

A. Some teeth must be removed for deeper penetration or slabby material

INFORMATION SHEET

B. Teeth must be removed in such a way that load is evenly distributed among remaining teeth

(NOTE: Usually this means removing the center tooth and then alternating every other one. Removing two out of three is also permitted, as long as care is taken to balance the scarifier.)

C. Teeth should always penetrate material and not be allowed to drag along surface

D. Teeth should be pitched for a firm grip into material being loosened

E. Teeth should penetrate as deeply as available power will allow

F. If motor grader blade is used in reverse position, blade must clear teeth

(NOTE: All teeth must either be removed or inverted.)

G. With scarifier in operation, the motor grader cannot turn, and all work must be done in straight lines

H. Motor grader must be operated at a slow speed when teeth are in ground

MOTOR GRADERS
UNIT I

JOB SHEET #1--PERFORM PRESTART INSPECTION AND MAINTENANCE PROCEDURES ON A MOTOR GRADER

I. Equipment and materials

   A. Motor grader

   B. Operator's manual

   C. Engine oil

   D. Engine coolant

   E. Hydraulic fluid

   F. Fuel

   G. Lubricants

   H. Grease gun

   I. Rags

II. Procedure

(NOTE: Equipment defects should be corrected immediately or reported to the proper authority. Do not operate defective equipment.)

   A. Make a walk-around visual inspection for leaks and for broken, worn, or missing parts

   B. Check engine oil level; add or change oil if needed

   C. Check engine coolant level; add coolant if needed

   D. Check hydraulic fluid level; add fluid if needed

   E. Check fuel level; fill tank if necessary

   F. Check battery connections for tightness and corrosion

   G. Check battery electrolyte level; add water if needed

   H. Check air cleaner; remove and clean filter if necessary

   I. Check brakes

   J. Check tires

JOB SHEET #1

K. Clean all grease fittings and lubricate according to specifications in operator's manual

(NOTE: Cleaning should include cylinders, pivot points, and drawbar bale.)

L. Check hydraulic system for leaking lines and connections, bent or kinked lines, and lines rubbing against other parts

M. Check drive belts for tightness

N. Check electrical wire connections and insulation

O. Clean windshield and mirrors; adjust mirrors

P. Check gauges

Q. Check foot pedals for proper functioning

R. Check levers and controls for proper functioning

S. Remove trash

T. Check lights

U. Check safety devices

V. Check major components

1. Circle drive, for leaks
2. Blade and end bits, for wear and damage and for loose or missing parts
3. Blade linkage, for damage and for loose or missing bolts
4. Pivot point, for dirt or debris buildup

MOTOR GRADERS
UNIT I

JOB SHEET #2--SERVICE A MOTOR GRADER

I. Equipment and materials

A. Motor grader

B. Operator's manual

C. Tool kit

D. Air supply

E. Grease gun

F. Lubricants

G. Cleaning solvents

H. Rags

I. Water

J. Engine coolant

K. Engine oil

L. Hydraulic fluid

M. Transmission fluid

N. Brake fluid

O. Tire pressure gauge

P. Fuel

II. Procedure

(NOTE: Follow departmental preventive-maintenance program when servicing equipment. Refer to operator's manual for lubrication chart and for manufacturer's recommendations for servicing specific components and attachments.)

A. Visually inspect for leaks and for broken, worn, or missing parts

(NOTE: Major repairs and replacements should be reported to the proper authority and completed by a trained mechanic.)

B. Check engine oil level, filter, lines, and hoses; add engine oil if needed

JOB SHEET #2

C. Check engine coolant level, radiator cap, hose, and radiator; add coolant if needed

(CAUTION: Do not remove radiator cap unless engine is cool; then, open cap slowly to release pressure.)

D. Clean air filter; replace if necessary

E. Check fuel level, fuel filters, and sediment bowl (where applicable); fill fuel tank if necessary

F. Check battery electrolyte level, battery cables, and connectors; add water if needed

(CAUTION: Keep sparks and fire away from battery.)

G. Check exhaust system for loose connections and holes

H. Check hydraulic fluid level, filters, hose, lines, and fittings; look for leaks; add fluid if required

I. Check transmission fluid level; add fluid if needed

J. Check transmission pressure-line filter and breather

K. Check brake adjustment and condition; adjust if necessary

L. Check brake master-cylinder fluid level; fill if necessary

M. Check fluid level in tandem drive cases; add fluid if needed

N. Check fluid level in circle-reverse gear case; add fluid if needed

O. Check clutch adjustment; adjust if necessary

P. Check drive belts for tension and wear; adjust or replace if necessary

Q. Check wiring, insulation, and connections

R. Clean and lubricate all grease fittings according to recommendations in operator's manual

S. Check condition of tires

T. Check tire pressure; inflate to recommended pressure if necessary

U. Check all safety devices; repair if necessary

V. Check windshield and windshield wipers; clean if needed

JOB SHEET #2

W. Check major components and/or accessories

1. Scarifier or other accessories
2. Circle drive, for leaks
3. Blade and end bits, for wear and damage and for loose or missing parts
4. Blade linkage, for damage and for loose or missing bolts
5. Pivot point, for dirt or debris buildup

MOTOR GRADERS
UNIT I

JOB SHEET #3--START, OPERATE, SHUT DOWN, AND SECURE A MOTOR GRADER

I. Equipment and materials

   A. Motor grader

   B. Operator's manual

II. Procedure for starting engine and operating motor grader

   A. Mount motor grader, using steps and grab irons

   B. Sit in operator's seat and secure seat belt

   C. Check operator's manual for specific instructions

   D. Set parking brake

   E. Place transmission in neutral

   F. Place all controls in hold, neutral, or off position

   G. Start engine

   (NOTE: In cold weather, check operator's manual for cold-weather starting procedures.)

      1. Move engine-speed control to halfway position and depress accelerator pedal

      2. Depress oil-pressure-bypass switch; turn key to cranking position

      3. Release key when engine starts

      (CAUTION: Do not crank engine for more than twenty seconds. Allow engine to cool for at least two minutes before attempting to start it again.)

      4. Release bypass switch when lubricating oil reaches operating pressure

   H. Allow engine to warm up

   I. Check gauges

JOB SHEET #3

J. While parking brake is set, operate all equipment controls possible

EXAMPLES: Raise and lower blade, shift blade, tilt blade, raise and lower right and left blade ends, rotate circle, shift circle, raise and lower scarifier or accessories, lean wheels, articulate

(NOTE: See operator's manual for specific instructions.)

(CAUTION: Any time you operate the blade lift cylinders, check operator's manual for correct saddle-pin (lock pin) operating procedures.)

K. Set engine-speed control at low idle

L. Raise all implements

M. Depress clutch if machine is so equipped

N. Position gearshift lever in desired speed range

(NOTE: Speed range will be determined by the type of job, ground conditions, and materials.)

O. Release parking brake

P. Release clutch pedal if machine is so equipped; gradually depress accelerator

Q. Shift gearshift lever into proper speed ranges as motor grader moves forward

(NOTE: Downshift one gear at a time. When downshifting under a load, increase engine speed to match ratio of lower gear.)

R. Stop grader

   1. Decrease engine speed by depressing decelerator
   2. Apply pressure to brake pedal
   3. Disengage engine foot clutch if applicable
   4. Shift gearshift lever to neutral
   5. Shift range-shift lever to neutral

S. Operate grader in forward and reverse gears

(NOTE: Bring grader to a complete stop before shifting from forward to reverse gears or from reverse to forward gears.)

T. Practice turns

JOB SHEET #3

U. Engage wheel-lean and operate motor grader in forward and reverse; turn

V. While in low gear and driving slowly, practice manipulating equipment controls

III. Procedure for shutting down engine and securing motor grader

(NOTE: When securing a motor grader, position the moldboard so that it is inboard of the wheel tracks for traveling. Drive the motor grader to the designated securing area and position it in a safe manner.)

A. Bring motor grader to a stop

B. Lower moldboard, scarifier, or any other hydraulically operated equipment

C. Set parking brake

D. Allow engine to idle three to five minutes with no load on it before shutting down

(NOTE: This permits the engine to cool down and allows for gradual and uniform cooling of engine parts. It also allows the turbocharger to slow down.)

E. Place engine-speed control in shutoff position

F. Turn key switch counterclockwise to off position

G. Relieve hydraulic pressure by moving levers and steering wheel until no response is felt

H. Dismount, using grab irons and steps

I. Make final visual inspection for leaks and for broken, loose, worn, or missing parts

MOTOR GRADERS
UNIT I

JOB SHEET #4--OPERATE AN ARTICULATED MOTOR GRADER

I. Equipment and materials

  A. Articulated motor grader

  B. Operator's manual

II. Procedure

  A. Mount motor grader, using steps and grab irons

  B. Sit in operator's seat and secure seat belt

  C. Check operator's manual for specific instructions

  D. Start engine and allow it to warm up

  E. Check all gauges and controls for proper functioning

  F. Set engine-speed control for desired rpm (low idle)

  G. Set gearshift lever in desired speed range

  H. Raise all implements

  I. Position gearshift lever in desired speed range

  J. Release parking brake

  K. With motor grader in straight mode, move forward through gearshift range

  L. Stop motor grader; place in articulated mode

  M. Operate in articulated mode

  (CAUTION: Be sure that blade clears tire.)

    1. Steer by articulating

    (NOTE: With the rear module on center, without moving the steering wheel, the motor grader can be steered to the left or right by sharply articulating the rear module.)

    (CAUTION: When the front tends to veer out of line, articulate the rear module in the opposite direction enough to overcome this tendency and hold the machine in line.)

JOB SHEET #4

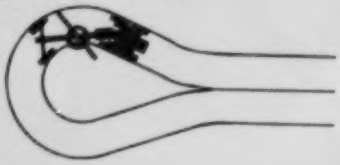
2. Turn motor grader around

   a. Lean wheels as you turn motor grader

   (NOTE: Leaning the wheels will decrease the turning radius. To turn right, lean the wheels to the right and articulate to the right. To turn left, lean the wheels to the left and articulate to the left.)

   b. Turn left and articulate left (Figure 23)

FIGURE 23

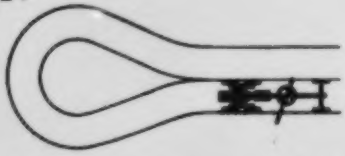


Turn left and articulate left.

Used with permission of Caterpillar Tractor Company.

   c. Turn right and articulate straight (Figure 24)

FIGURE 24



Turn right and articulate straight. Continue to grade.

Used with permission of Caterpillar Tractor Company.

   d. Continue to grade

N. Stop motor grader and place in straight mode

O. Return to parking area; stop and secure motor grader

P. Dismount, using grab irons and steps

Q. Make final visual inspection for leaks and for broken, worn, loose, or missing parts

MOTOR GRADERS
UNIT I

JOB SHEET #5--CHANGE THE BLADE ON A MOTOR GRADER

I. Equipment and materials

- A. Motor grader
- B. Operator's manual
- C. Tool kit containing hand or power wrenches of the correct size
- D. Two sections of replacement blades (cutting edges)
- E. Plow bolts with nuts of the correct size for replacement if necessary
- F. Four 6" x 6" x 18" wood blocks
- G. Recommended safety equipment
    1. Hard hat
    2. Gloves
    3. Close-fitting clothing

II. Procedure

(NOTE: If end bits need to be replaced, do so while the ends of the moldboard are suspended for replacing the cutting edges.)

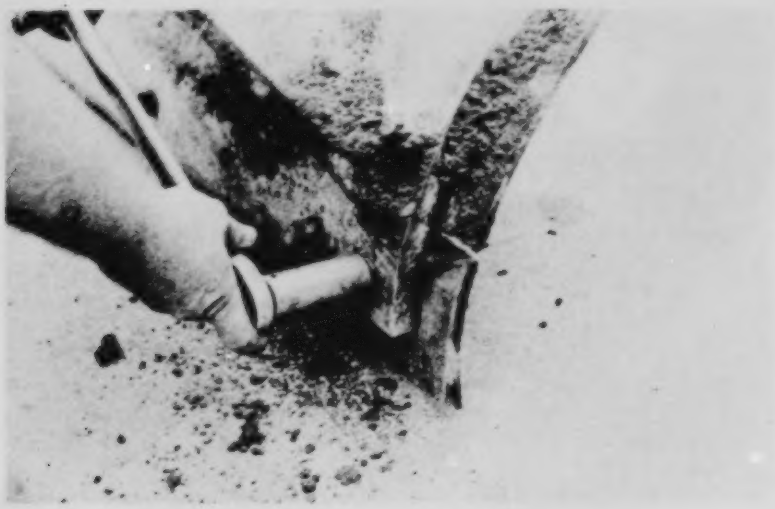
- A. Block tandem wheels, front and back
- B. Mount cab correctly and sit in operator's seat
- C. Perform starting procedure

    (NOTE: Make sure parking brake is set.)
- D. Lower moldboard until it just touches ground with no down pressure
- E. Shut down grader and dismount properly

JOB SHEET #5

F. Remove bolts from right section of cutting edge (Figure 25)

FIGURE 25



G. Kick blade free

(NOTE: Stand in front of blade and kick so that it falls away from you off the rear of the moldboard.)

H. Set new section of cutting edge in place

I. Insert bolts and secure with nuts

(NOTE: If bolts are worn, replace them.)

J. Tighten bolts according to manufacturer's recommendations

(NOTE: Set to recommended torque, using power tools.)

K. Remove blocks from wheels

L. Mount machine properly and start motor grader

M. Lower moldboard until full weight is on ground

N. Move all controls to neutral position

O. Perform shut-down procedures

P. Dismount properly

Q. Pick up tools and blocks and store properly; discard worn cutting edges

JOB SHEET #5

III. Alternate procedures

A. Raise blade evenly about 8 inches above ground; place a block at each end of moldboard to change both sections at once

B. Raise one end of moldboard until opposite end rests on ground

C. Change one section; reverse procedure and change other section

MOTOR GRADERS
UNIT I

JOB SHEET #6--TURN A MOTOR GRADER AROUND

I. Equipment--Motor grader

II. Procedure

(NOTE: When a motor grader makes a number of passes over a distance of less than 1,000 feet, it is usually more efficient to back the grader the entire distance to the starting point than to turn around and continue working from the far end. But, if your passes cover a distance of 1,000 feet or more, as in snow removal, it is more efficient to turn the grader around and start blading from the far end to the starting point. The combined maneuvering advantages of leaning wheels and tandem drive are a big help in turning the machine around.)

A. Lean front wheels in direction of turn (Figure 26, A)

(NOTE: This will move the front end of the motor grader over and enable you to make a shorter turn.)

B. Back across the ditch or roadway (Figure 26, B)

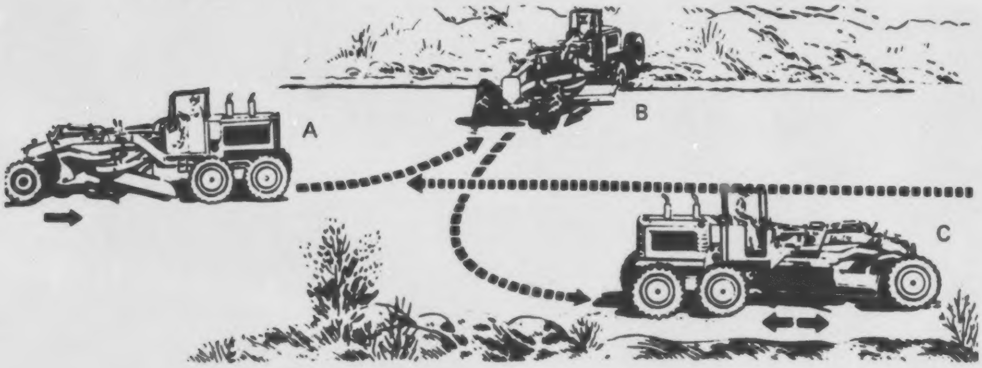
C. Stop motor grader and shift gears

D. Lean front wheels in other direction

E. Complete the turn (Figure 26, C)

(NOTE: You will find that when you leave the wheels on grade and lean in the direction of the turn, the motor grader will make the turn with ease. Always *back across* the road or ditch and *leave* the front wheels on the roadway.)

FIGURE 26



MOTOR GRADERS
UNIT I

JOB SHEET #7--MAKE A WINDROW

I. Equipment--Motor grader

II. Procedure

A. Mount motor grader, using steps and grab irons

B. Sit in operator's seat and secure seat belt

C. Start engine and allow it to warm up; listen for unusual noises

D. Raise blade off ground

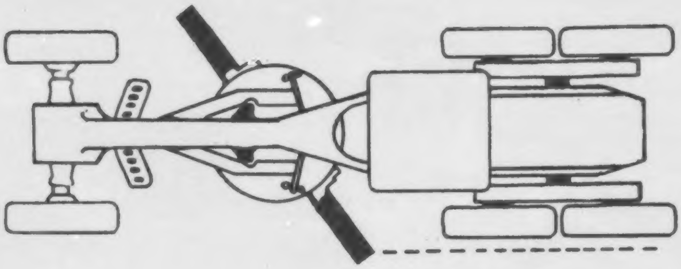
E. Release parking brake and transmission lock

F. Select first forward gear and move to area to be graded

G. Circle blade left to position toe of blade behind right front tire

H. To avoid driving over windrow, slide blade shift so that heel is clear of left tandem drive wheel (Figure 27)

FIGURE 27

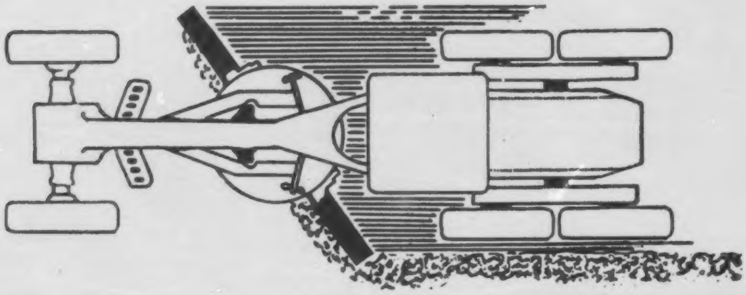


JOB SHEET #7

I. Lower toe and heel of blade to begin cutting material

(NOTE: As desired depth is reached, material should flow freely to heel of blade and form the windrow. See Figure 28.)

FIGURE 28



J. Continue making windrow until reaching end of cut

K. Raise blade clear of ground and stop

L. Select reverse and back up--looking behind the machine--until you return to starting point

M. Stop and select first forward gear

N. Move machine to the left and position right front tire to right of previous windrow (straddle previous windrow with motor grader)

O. Lower blade to ground to make a light grading pass; observe material flowing to left heel of blade

P. As windrow becomes larger, the motor grader's front tires should lean toward windrow to conteract side drift

Q. Continue process until windrow is desired size

MOTOR GRADERS
UNIT I

JOB SHEET #8--CUT A FIREBREAK

I. Equipment--Motor grader

II. Procedure

A. Mount motor grader, using steps and grab irons

B. Sit in operator's seat and secure seat belt

C. Start engine and allow it to warm up; listen for unusual noises

D. Raise blade to clear ground

E. Release parking brake and transmission lock

F. Select travel speed, and proceed to area where firebreak is to be made

G. Downshift to working speed and position the circle to sidecast material (toe of the blade behind front tire)

H. Lower blade to ground and begin stripping material from center to outside

I. Continue cutting firebreak, making any adjustments necessary to keep the machine moving and sidecasting material

(NOTE: If firebreak is being cut while fire is burning, speed is of great importance.)

J. When end of lane is reached, turn motor grader around and line up to sidecast from center to opposite side

K. Continue return cut, making any adjustments; lean wheels in opposite direction of blade toe to counteract side drift

L. Repeat process until firebreak is complete

MOTOR GRADERS
UNIT I

JOB SHEET #9--REMOVE SNOW

I. Equipment--Motor grader

II. Procedure

A. Mount motor grader, using steps and grab irons

(CAUTION: Steps and irons could have ice on them.)

B. Sit in operator's seat and secure safety belt

C. Start engine and allow it to warm up; listen for unusual noises

D. Raise blade off ground

E. Release parking brake and transmission lock

F. Select travel speed, and move to area to be cleared

G. Downshift to working speed

H. Tip moldboard forward

I. Rotate circle to sidecast material

J. Line up left front wheel of motor grader on center line of road

K. Lower blade to just touch pavement

L. Lean wheels in direction of sidecast snow

M. Continue removing snow until destination is reached

(NOTE: Check blade wear frequently during operation to prevent moldboard damage.)

N. Raise blade and turn machine around

O. Reposition motor grader on opposite side of road for return pass

P. Line up left side, placing wheel on grade area

Q. Lower blade to pavement and continue snow removal while making any adjustments necessary to avoid scarring road

R. When area is cleared of snow, raise blade and move to another area to be cleared

MOTOR GRADERS
UNIT I

JOB SHEET #10--BLEND AND SPREAD MATERIAL ON A ROADBED

I. Equipment and materials

   A. Motor grader

   B. Sand, aggrégate, or asphalt material

II. Procedure for rigid-frame motor grader

   A. Adjust blade to forward position

      (NOTE: This blade position will create a rolling and mixing action.)

   B. Proceed to work area

   C. Start first pass, cutting approximately one-third of windrow material

   D. Continue cutting and moving windrow in portions until mix is uniform

   E. After obtaining designated mix, position blade at a 20-degree to 30-degree angle and spread material on roadbed by windrowing back and forth across roadbed

III. Procedure for an articulated motor grader

   A. Ground motor grader blade

   B. Extend moldboard and circle as needed

   C. Articulate rear tandems toward pile

      (NOTE: This puts the weight of the machine behind the point of maximum load while allowing the front wheels to run on level ground.)

   D. Start first pass, cutting approximately one-third of windrow material

   E. Continue cutting and moving windrow in portions until mix is uniform

   F. After obtaining designated mix, position blade at a 20-degree to 30-degree angle and spread material on road by windrowing back and forth across roadbed

MOTOR GRADERS
UNIT I

JOB SHEET #11--GRADE AN UNPAVED ROAD

I. Equipment--Motor grader

II. Procedure

(NOTE: The ideal time for grading an unpaved road is after the roadbed has received moisture and has dried out just enough so that the binding material will stick to the larger pieces, cementing it all.)

A. Mount motor grader, using steps and grab irons

B. Take position in operator's seat and secure seat belt

C. Start engine; listen for unusual noises

D. Warm up engine before operation begins

E. Raise blade to transportation height

F. Release parking brake and transmission lock

G. Make final check of area for clearance

H. Make sure traffic-control devices are in place

I. Downshift to working speed

J. Position blade at a 20-degree to 30-degree angle with toe of blade back of *right* front wheel

K. Position motor grader to grade from right barrow ditch or shoulder toward center of road on first pass

L. Lower blade to desired depth of cut when motor grader is in position

(NOTE: Start on right side of road with toe of blade at bottom of barrow ditch or at edge of shoulder.)

M. Begin grading

N. At end of graded section, raise blade and turn motor grader around

O. Position blade at a 20-degree to 30-degree angle with toe of blade just outside of *left* front wheel

P. Adjust blade to maintain crown in road

(NOTE: If road is left flat or low in the center, water will not drain to the sides. Poor drainage creates a condition that causes early potholes and ruts.)

JOB SHEET #11

Q. Lower blade and begin grading; continue back to starting point

R. Before leaving work area, remove any boulders or debris loosened by the grading operation

MOTOR GRADERS
UNIT I

JOB SHEET #12--PERFORM V-TYPE DITCH CONSTRUCTION

I. Equipment--Motor grader

II. Procedure

A. Interpret data on ditch stake

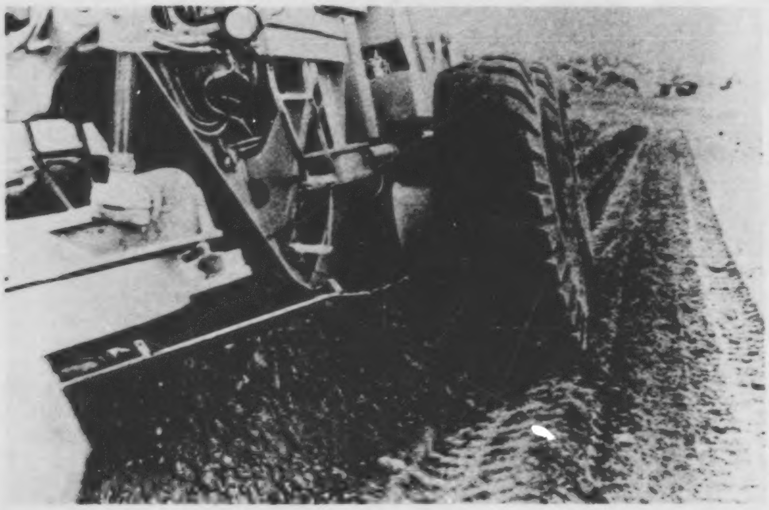
B. Operate side shift to extreme left

(NOTE: With an articulated motor grader, articluate so that tandems run outside of the "V" where traction is better.)

C. Rotate circle until toe of blade is directly behind right front wheel

D. Raise left lift cylinder to full UP position (Figure 29)

FIGURE 29

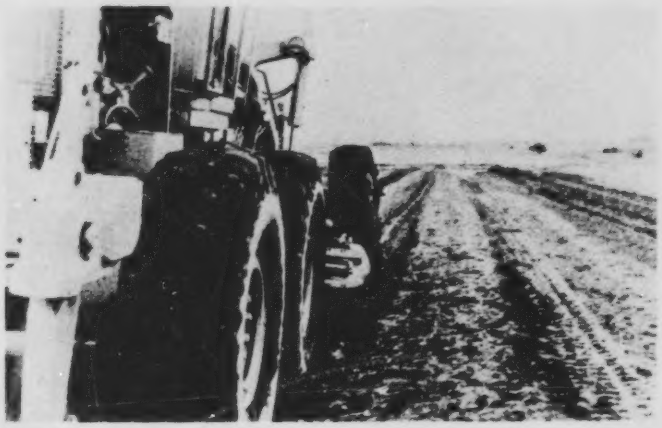


Courtesy of Caterpillar Tractor Company.

JOB SHEET #12

E. Lower right blade-lift cylinder to set blade tip for desired depth of cut (Figure 30)

FIGURE 30



Courtesy of Caterpillar Tractor Company.

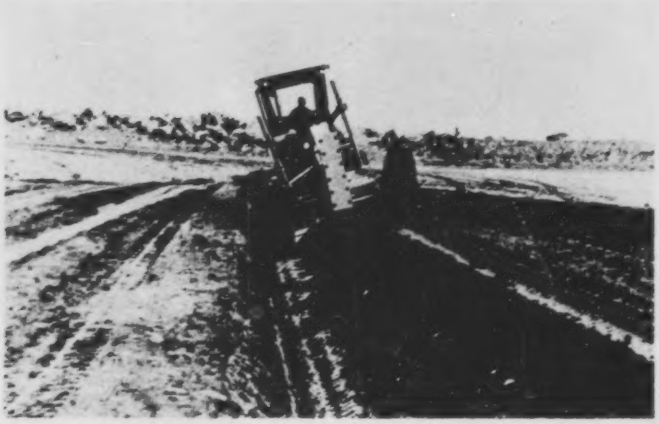
F. Lean front wheels to left and make a 4-inch to 5-inch marking cut

(NOTE: Leaning will counteract side drift of blade. Keep blade toe in line with outside edge of lead tire while maintaining a straight line.)

G. Continue cutting to desired depth, keeping front tire in bottom of ditch (Figure 31)

(NOTE: Each ditch cut should be made as deep as possible with blade toe in line with center of lead tire, and without stalling grader.)

FIGURE 31



Courtesy of Caterpillar Tractor Company.

JOB SHEET #12

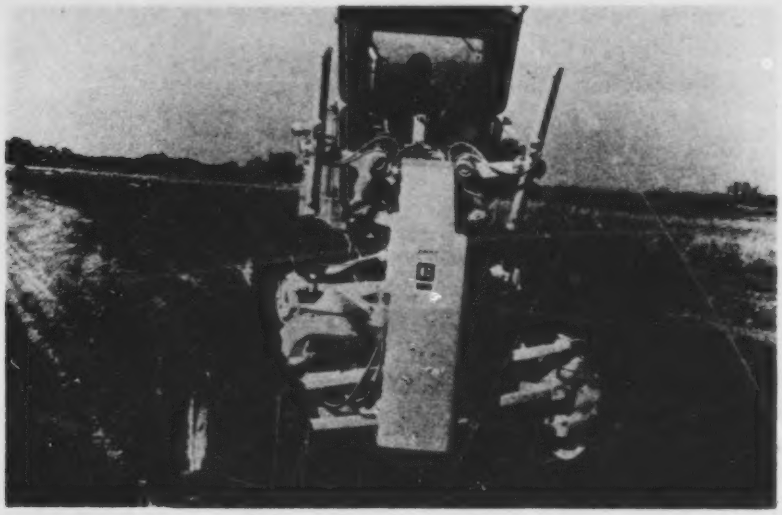
H. Continue ditching and bringing successive cuts in from edge of bank slope; blade toe will be in line with bottom of ditch on final cut

III. Procedure for wet-ditch grading with an articulated motor grader

(NOTE: This procedure may be used for wet-ditch grading, or to avoid obstructions when cleaning old ditches that may have tree overhangs, or rock ledges.)

A. Articulate motor grader so that front wheels and blade are in the ditch (crab mode) (Figure 32)

FIGURE 32



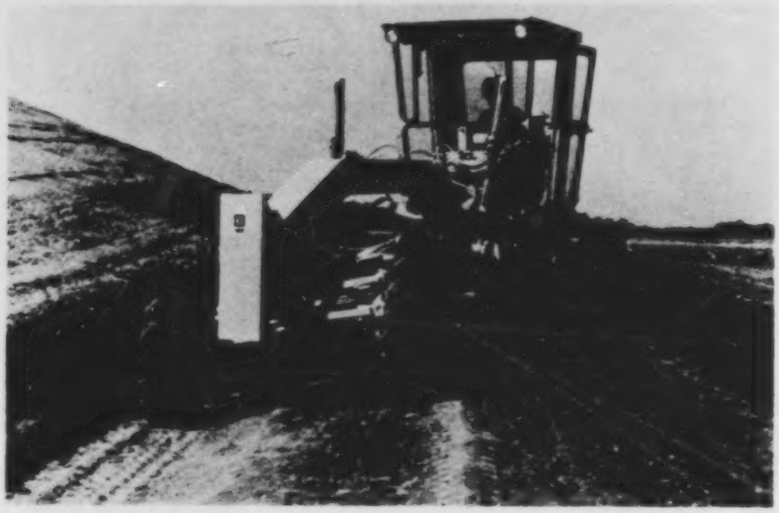
Courtesy of Caterpillar Tractor Company.

B. Steer with front wheels

JOB SHEET #12

C. Keep rear wheels on shoulder to prevent wheels from slipping in wet or soft material in ditch (Figure 33)

FIGURE 33



Courtesy of Caterpillar Tractor Company.

MOTOR GRADERS
UNIT I

JOB SHEET #13--SCARIFY A SECTION OF ASPHALT ROAD

I. Equipment and materials

A. Motor grader equipped with scarifier log and teeth

B. Operator's manual

C. 24-ounce ball peen hammer

D. Recommended safety equipment

1. Hard hat
2. Gloves
3. Close-fitting clothing

II. Procedure

(NOTE: This procedure is for scarifying a section of single-course surface treatment.)

A. Read operator's manual

B. With ball peen hammer, insert full set of teeth (usually eleven) in scarifer

C. Make walk-around visual inspection of motor grader

D. Make necessary minor repairs or adjustments

E. Be sure that all traffic-control devices are in place

F. Mount motor grader, using steps and grab irons

G. Take position in operator's seat and secure seat belt

H. Start and warm up engine before operation begins

I. Position grader about 20 feet from starting point on right side of roadway

J. Lower scarifer log until teeth are about 2 inches above pavement

K. Shift transmission into low range

L. Move forward at a speed that allows you to reach operating speed and lower scarifying teeth to desired cutting depth at starting point

(NOTE: If motor grader lugs or stalls, there are two options: [1] reduce the depth of the teeth or [2] remove a tooth or teeth from each end of the log. Always take the same number of teeth from each end of log.)

JOB SHEET #13

M. Continue scarifying in a straight line

(NOTE: If teeth have a tendency to ride on top of the road surface, adjust pitch nearer to 90 degrees to the pavement. This adjustment can be made while the motor grader is moving. See operator's manual.)

N. When end of scheduled distance to be scarified is reached, raise teeth 4 inches to 6 inches above pavement

O. Turn motor grader around

(NOTE: If the scarifier log is mounted in front of the front wheels, turn grader in the normal way. If the log is mounted behind the front wheels, rotate the blade while teeth are in scarifying position.)

P. Repeat steps I through N

Q. Continue until entire width of road has been scarified

R. Raise teeth to travel height

S. Move motor grader off pavement to a safe and fairly level parking place

T. Put on emergency brake

U. Lower blade until it presses against the ground

V. Shut down engine

W. Dismount in a safe manner

X. Make a final visual inspection of motor grader

Y. List any equipment defects found during the visual inspection, and give the list to proper authorities

MOTOR GRADERS
UNIT I

TEST

NAME ______________________________ SCORE ____________

1. Match terms associated with motor graders to their correct definitions. Write the correct numbers in the blanks.

_____ a. Pushing load drifts to trailing end of blade

_____ b. Attachments used to increase a machine's versatility and effectiveness

_____ c. Leading end of motor grader blade

_____ d. Ridge of loose material

_____ e. To mix materials until they are uniform

_____ f. Hub stakes used during final grading process when existing grade is within 0.2 foot of desired grade

_____ g. Jointed

_____ h. To build up middle of roadbed so that water will flow to sides

_____ i. Trailing end of motor grader blade

_____ j. Machine with centrally located blade that can be angled to cast to either side; may be rigid frame or articulated frame; has independent hoist control on each side

_____ k. Colored marking crayon used to mark tops of blue-top stakes

_____ l. Area cleared of combustible materials

_____ m. To loosen the road surface

1. Keel
2. Toe
3. Articulated
4. Firebreak
5. Scarify
6. Windrow
7. Accessories
8. Heel
9. Blend
10. Motor grader
11. Crown
12. Blue tops
13. Sidecasting

2. List five uses of a motor grader.

a. ______________________________

b. ______________________________

c. ______________________________

d. ______________________________

e. ______________________________

TEST

3. Select from the following list types of highway-maintenance jobs done with motor graders. Write an "X" in the blank before each correct answer.

_____a. Scarifying or ripping

_____b. Mixing and spreading materials

_____c. Compacting

_____d. Leveling

_____e. Crawler towing

_____f. V-type ditch construction

_____g. Plowing and planting

_____h. Land clearing

_____i. Snow removal

_____j. Finish grading

_____k. Road maintenance

_____l. Ditch dredging

_____m. Reverse blading

_____n. Culvert installation

_____o. Flat-bottom ditch cutting

_____p. Bank sloping

TEST

4. Identify basic parts of a motor grader. Write the correct numbers in the blanks.

______a. Blade-lift cylinder

______b. Mirror

______c. Frame-steer cylinder

______d. Circle-drive gearbox

______e. Scarifier

______f. Muffler

______g. Work lights

______h. Main frame

______i. Engine side shield

______j. Precleaner

______k. Turn-signal light

______l. Front-wheel-drive motor

______m. Radiator grill

______n. End bit

______o. Draft frame

______p. Cab

______q. Circle side-shift cylinder

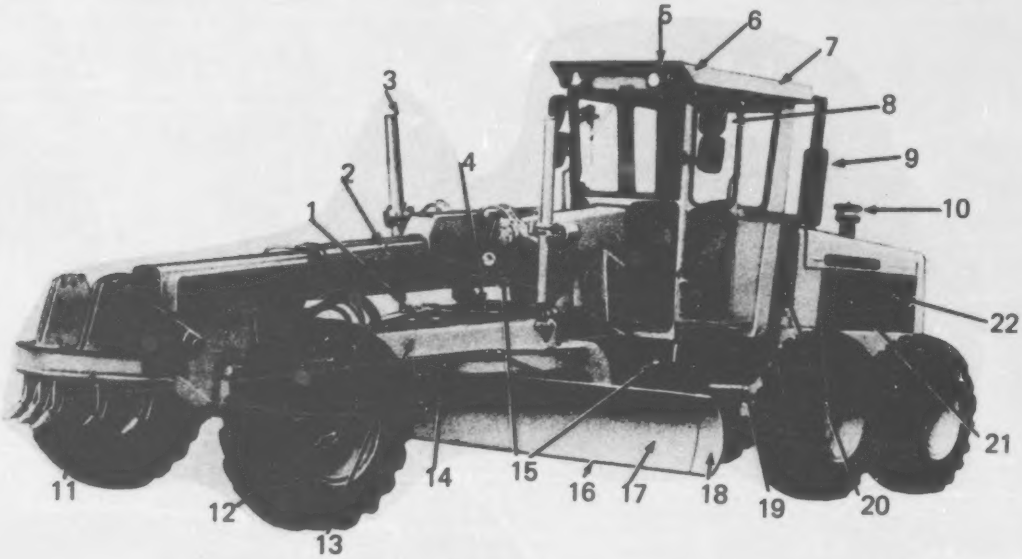
______r. Driving light

______s. Moldboard (blade)

______t. Circle

______u. Service door

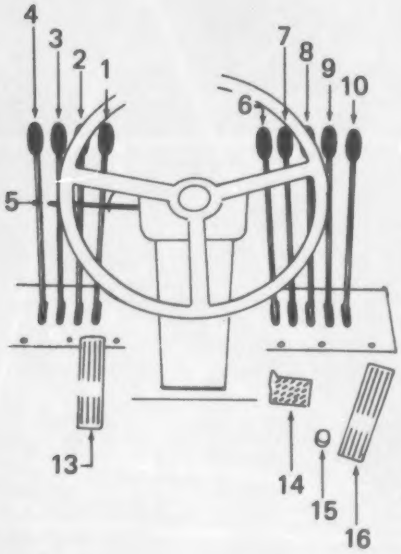
______v. Cutting edge

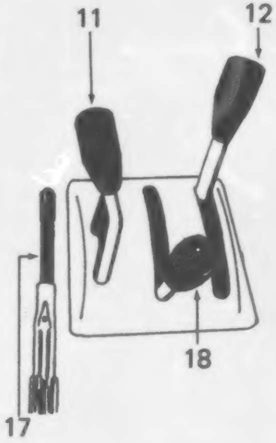


TEST

5. Identify typical motor grader controls. Write the correct numbers in the blanks.

______a. Forward/reverse control lever
______b. Blade tilt lever
______c. Right blade-lift lever
______d. Accelerator pedal
______e. Scarifier/accessory control lever
______f. Wheel-lean lever
______g. Gear-range lever
______h. Turn signals and emergency flasher
______i. Engine-speed control (hand throttle)
______j. Circle rotation lever
______k. Articulation control lever
______l. Decelerator pedal
______m. Circle shift lever
______n. Blade shift lever
______o. Parking-brake lever
______p. Saddle-pin release button or pedal
______q. Brake pedal
______r. Left blade-lift lever





TEST

6. Match motor grader controls to their correct functions. Write the correct numbers in the blanks.

______a. Moves moldboard to right or left

______b. Stops or slows machine

______c. Governs engine speed

______d. Raises or lowers scarifier

______e. Increases speed quickly

______f. Raises and lowers left end of blade

______g. Controls wheel speeds

______h. Moves blade rearward or forward

______i. Selects gear range

______j. Hydraulically releases saddle pin for changing blade position

______k. Tilts front wheels to right or left

______l. Moves circle to right or left

______m. Moves rear module from center to right or left

______n. Decreases speed quickly

______o. Secures motor grader when stopped or parked

______p. Raises and lowers right end of blade

______q. Moves circle clockwise or counterclockwise

______r. Moves motor grader forward or rearward

1. Decelerator pedal
2. Forward/reverse control lever
3. Circle rotation lever
4. Wheel-lean lever
5. Differential lock
6. Blade shift lever
7. Left blade-lift lever
8. Right blade-lift lever
9. Parking-brake lever
10. Brake pedal
11. Accelerator pedal
12. Blade tilt lever
13. Engine-speed control (hand throttle)
14. Gear-range lever (transmission control)
15. Circle shift lever
16. Saddle-pin release button or pedal
17. Articulation control lever
18. Scarifier/accessory control lever

TEST

7. Match motor grader accessories to their correct uses. Write the correct numbers in the blanks.

_____ a. Used to remove snow and cast it away from roadway

_____ b. Used to loosen hard soil and soft rock on road surface to be bladed

_____ c. Used for shallow loosening of road surface to be bladed

_____ d. Used for laying asphalt material

_____ e. Used to remove large drifts

1. Ripper
2. Side wing (snow wing)
3. Snow plow (V-type)
4. Scarifier (or scarifier/ripper)
5. Serrated blade

8. State eight general safety rules for operating equipment.

a. ____

b. ____

c. ____

d. ____

e. ____

f. ____

g. ____

h. ____

9. State eight safety rules for operating a motor grader.

a. ____

b. ____

c. ____

d. ____

e. ____

f. ____

g. ____

h. ____

TEST

10. Select from the following list principles of moldboard operation. Write an "X" in the blank before each correct answer.

_____a. Raising or lowering the blade determines depth of cut

_____b. For spreading or maintaining surface material and for snow removal, blade is pitched farther forward

_____c. As blade wears down, lower moldboard

_____d. As angle decreases, a greater amount of the load is drifted straight ahead

_____e. Raising the blade determines whether material is cast into windrows or spread evenly

_____f. As angle increases, a greater amount of the load is drifted straight ahead

_____g. Blade tilt determines whether material is cast into windrows or spread evenly

_____h. For normal grading operations, blade is kept near center of pitch adjustment so that tip of blade is directly over cutting edge

_____i. The greater the angle of the moldboard, the more earth will spill off the heel

_____j. Pitch adjustment determines depth

_____k. For greater cutting action, blade is pitched backward

_____l. For greater cutting action, blade is pitched forward

_____m. For mixing and laying operations, blade is pitched slightly forward

_____n. For faster operation, blade is raised slightly

_____o. Pitch adjustment produces a cutting or dragging action

11. Match specific conditions to correct techniques of motor grader operation. Write the correct numbers in the blanks.

_____a. Lean top of wheels away from direction of windrow

_____b. Lean top of wheels toward bank

_____c. Change blade from forward to reverse grading position, a circle-reverse movement of about 70 degrees

_____d. Lean top of front wheels enough to keep them in a vertical working position

_____e. Be sure scarifier hang rods are shortened and scarifier teeth are removed

1. Reverse blading
2. Jobs confined to short stretches or narrow widths
3. Normal operations
4. Working around curves
5. High bank-cutting operations
6. Working on sloping side of a ditch

TEST

_____f. Always lean top of front wheels in direction of turn

12. Distinguish among straight-mode, articulated-mode, and crab-mode techniques for operating an articulated motor grader. Write an "S" in the blanks before operations using the straight mode, an "A" before operations using the articulated mode, and a "C" before operations using the crab mode.

_____a. Spreading material

_____b. Scarifying

_____c. Smoothing washboards

_____d. Heavy windrowing operations

_____e. V-ditch construction

_____f. Long-pass blading

_____g. Short turns

_____h. Blading shoulders on paved roads

_____i. Cutting a high bank

_____j. Wet-ditch cleaning

_____k. Blading shoulders on unpaved roads

_____l. Cutting a bank on a gentle slope (4:1)

_____m. Dry-ditch cleaning

_____n. Operating in tight areas

13. Select from the following list procedures for effective motor grader operation. Write an "X" in the blank before each correct answer.

_____a. Operate at low to middle throttle

_____b. Set as short a work cycle as possible

_____c. Inspect blade frequently during operation to prevent moldboard damage

_____d. Always use decelerator or throttle to slow engine speed when shifting

_____e. When front module veers, move it in opposite direction enough to correct and hold machine in line

_____f. Perform all prestart inspection and maintenance procedures

_____g. Operate each gear at full throttle

TEST

_____ h. Keep equipment clean

_____ i. Write down any defective operation on a note pad

_____ j. When rear module veers, move it in opposite direction enough to correct and hold machine in line (articulated motor grader only)

_____ k. Do not work machine over capacity

_____ l. Protect motor grader from dust and sand as much as possible

_____ m. Plan operations before starting

_____ n. For snow removal, check blade for damage every thirty minutes

_____ o. When transporting motor grader, cover rain cap to protect turbocharger

_____ p. Use a lower gear when less speed is required

_____ q. When rear module veers, move it in direction of veer enough to correct and hold machine in line

_____ r. When front end tends to veer out of line, lean wheels in direction of veer enough to correct and hold machine in line

_____ s. Use extreme care when turning on a downgrade

_____ t. Service equipment regularly to ensure efficient operation

_____ u. When front end tends to veer out of line, lean wheels in *opposite direction* enough to correct and hold machine in line (articulated motor grader only)

_____ v. Travel at highest practical travel speed that conditions will allow

14. Match windrow and pile placement to their correct operations. Write the correct numbers in the blanks.

_____ a. Keep windrow toward middle of road, away from ditching operation

_____ b. Spread and dump pile as much as possible

_____ c. Push pile straight ahead and spread

_____ d. Keep a partial load in front of blade to distribute it

_____ e. Keep windrow toward shoulder

1. Leveling
2. Snow removal
3. Dozing
4. Spreading
5. Ditching

TEST

15. Select from the following list principles of scarifier operation. Write an "X" in the blank before each correct answer.

_____a. No more than five teeth may be removed for scarifier operation

_____b. Lean front wheels when scarifying around curves

_____c. If motor grader blade is used in reverse position, blade must clear teeth

_____d. Teeth must be inverted when roading motor grader

_____e. Motor grader must be operated at a slow speed when teeth are in ground

_____f. Full set of teeth is used for deep penetration and heavy work

_____g. Motor grader must be operated at high speed when teeth are in ground

_____h. Teeth should always penetrate material and not be allowed to drag along surface

_____i. No more than three teeth may be removed

_____j. Teeth must be removed in such a way that load is evenly distributed among remaining teeth

_____k. Some teeth must be removed for deeper penetration or slabby material

_____l. With scarifier in operation, the motor grader cannot turn, and all work must be done in straight lines

_____m. Teeth should penetrate as deeply as available power will allow

_____n. Teeth should be pitched for a firm grip into material being loosened

(NOTE: Test question 16 lists the job sheets. They are an important part of this test. If they have not been completed, check with your instructor.)

16. Demonstrate the ability to

    a. Perform prestart inspection and maintenance procedures on a motor grader.

    b. Service a motor grader.

    c. Start, operate, shut down, and secure a motor grader.

    d. Operate an articulated motor grader.

    e. Change the blade on a motor grader.

    f. Turn a motor grader around.

    g. Make a windrow.

    h. Cut a firebreak.

TEST

i. Remove snow.

j. Blend and spread material on a roadbed.

k. Grade an unpaved road.

l. Perform V-type ditch construction.

m. Scarify a section of asphalt road.

MOTOR GRADERS
UNIT I

ANSWERS TO TEST

1.

a.	13	h.	11
b.	7	i.	8
c.	2	j.	10
d.	6	k.	1
e.	9	l.	4
f.	12	m.	5
g.	3		

2. Answer should include any five of the following
   a. Cutting
   b. Shaping
   c. Earth moving
   d. Spreading
   e. Fine grading
   f. Snow and ice control

3. a, b, d, f, i, j, k, m, o, p

4.

a.	3	h.	2	o.	13	v.	16
b.	8	i.	21	p.	7		
c.	19	j.	10	q.	4		
d.	1	k.	6	r.	5		
e.	11	l.	12	s.	17		
f.	9	m.	20	t.	14		
g.	15	n.	18	u.	22		

ANSWERS TO TEST

5.	a.	11	g.	18	m.	8
	b.	1	h.	5	n.	6
	c.	10	i.	12	o.	17
	d.	16	j.	2	p.	15
	e.	3	k.	9	q.	14
	f.	7	l.	13	r.	4

6.	a.	6	g.	5	m.	17
	b.	10	h.	12	n.	1
	c.	13	i.	14	o.	9
	d.	18	j.	16	p.	8
	e.	11	k.	4	q.	3
	f.	7	l.	15	r.	2

7.	a.	2
	b.	1
	c.	4
	d.	5
	e.	3

8. Answer should include any eight of the following
    a. Wear safetv items required by job conditions
    b. Know and observe hand signals
    c. Be sure all safety guards and covers are secure and in place
    d. Do not operate machine until you are sure personnel and obstructions are cleared from area
    e. Check all safety devices before moving machine
    f. Do not jump on or off machine
    g. Mount and dismount properly, using handholds and steps

ANSWERS TO TEST

- h. Do not allow anyone to ride on machine
- i. Know traffic pattern of job and obey spotter
- j. Always park on level ground if possible
- k. Do not leave machine unattended while engine is running
- l. Avoid operating too close to banks or overhangs
- m. Watch for overhead electrical power lines
- n. Watch for flags indicating buried pipes and power and gas lines
- o. Keep equipment clean

9. Answer should include any eight of the following
   - a. Read operator's manual thoroughly: know your machine
   - b. Do not start or operate motor grader unless you are in operator's station
   - c. Make a walk-around visual inspection to observe physical condition of machine before moving it
   - d. Drive carefully on hillsides and curves to avoid tipping
   - e. Reduce speed before turning or applying brakes
   - f. Use brake pedals together when traveling, and especially when making an emergency stop
   - g. Drive at speeds slow enough to ensure your safety, especially over rough ground
   - h. Travel with blade inboard of wheel tracks
   - i. Lower blade to ground when securing or working on machine
   - j. Bring motor grader to a *complete stop* before shifting from a forward gear to a reverse gear, or from a reverse gear to a forward gear
   - k. Do not use motor grader or blade as a battering ram

10. a, b, d, e, h, i, k, m, o

11.

a.	3	d.	6
b.	5	e.	1
c.	2	f.	4

ANSWERS TO TEST

12.	a.	A	h.	S
	b.	S	i.	A
	c.	C	j.	C
	d.	C	k.	A
	e.	A	l.	C
	f.	S	m.	S
	g.	A	n.	A

13. b, c, d, f, g, h, j, k, l, m, o, p, s, t, u, v

14.	a.	5	d.	1
	b.	4	e.	2
	c.	3		

15. c, e, h, j, k, l, m, n

16. Performance skills evaluated to the satisfaction of the instructor

ASPHALT DISTRIBUTOR
UNIT II

UNIT OBJECTIVE

After completing this unit, the student should be able to safely and effectively operate an asphalt distributor. This knowledge will be shown by completing assignment sheets, job sheets, and unit test with a minimum score of 85 percent.

SPECIFIC OBJECTIVES

After completing this unit, the student should be able to

1. Match terms associated with asphalt distributors to their correct definitions.
2. State key factors in effective asphalt distributor operation.
3. Select from a list uses of an asphalt distributor in highway maintenance.
4. Identify parts of a typical asphalt distributor.
5. Distinguish between characteristics of hydrostatic drive and characteristics of engine drive.
6. Match controls on a typical asphalt distributor to their correct functions.
7. Match materials used in asphalt distributors to their correct uses.
8. Identify characteristics of cutback and emulsion materials.
9. State safety precautions for operating an asphalt distributor.
10. State procedures for working effectively with spreader.
11. Select from a list asphalt distributor operating functions.
12. State safety rules for operating burners.
13. Select from a list guidelines for effective distributor operation.
14. Select from a list factors that determine rate of spray.
15. State procedures for uniform material distribution.
16. Arrange in order the steps in a penetration operation.
17. Complete a safety test on asphalt distributors.
18. Distinguish between cutback and emulsion materials.

OBJECTIVE SHEET

19. Demonstrate the ability to
    a. Perform prestart inspection and maintenance procedures on an asphalt distributor.
    b. Service an asphalt distributor.
    c. Light burners, circulate material, and shut down burners.
    d. Perform tank operations on an asphalt distributor.
    e. Spray a section of roadway.

ASPHALT DISTRIBUTOR
UNIT II

SUGGESTED ACTIVITIES

I. Suggested activities

A. Order materials planned to supplement unit.

1. Catalog--*Publications and Visual Aids.* The Asphalt Institute. Available from The Asphalt Institute, Asphalt Institute Building, College Park, Maryland 20740, 301/277-4258.

    (NOTE: This catalog lists publications, films, and slide presentations on all aspects of asphalt materials and their applications. It will be useful for all units relating to asphalt operations.)

2. Slide/cassette presentations

    a. *Asphalt Surface Maintenance.* Color, 120 minutes, Arkansas State Highway Department. Available from Oklahoma Department of Transportation, 200 N.E. 21, Oklahoma City, Oklahoma 73105, 405/521-4141. Order code 322-77-1-4.

    (NOTE: This slide series comes in four parts. Part one, *Asphalt Surface Care*, is the first in a series of courses that describes the patching, leveling, and sealing that needs to be done to maintain asphalt surfaces. Part two, *Patching Asphalt Surfaces*, explains how to repair potholes, edge failures, broken surfaces, and similar defects. Part three, *Pre-Mix Leveling Operations*, explains how to restore asphalt surfaces to their original shape by filling in depressions, wheel ruts, and other distortions. Part four, *Sealing Asphalt Surfaces*, deals with spot sealing with seal coat or fog seal.)

    b. *Pavement Maintenance, #1, #2, #3.* Color, 60 minutes, The Asphalt Institute. Available from The Asphalt Institute, Asphalt Institute Building, College Park, Maryland 20740.

    (NOTE: This series shows the maintenance of asphalt roads and the right way to fill cracks.)

    c. *Field Placement of Signs.* Color, 40 minutes, Traffic Technician Seminar. Available from Oklahoma Department of Transportation, 200 N.E. 21, Oklahoma City, Oklahoma 73105, 405/521-4141. Order Code No. 322-79-1-6.

    (NOTE: This presentation demonstrates good sign placement and discusses the proper types of installation, placement, and maintenance techniques for various signs.)

SUGGESTED ACTIVITIES

3. Video tape program--*Save That Road (Part 1).* Color, 20 minutes, Oklahoma State University, 1980. Available from Department of Transportation, 200 N.E. 21, Oklahoma City, Oklahoma 73105, 405/521-4141. Order No. 425-79-1-1.

   (NOTE: This program illustrates the various types of failures that occur routinely in asphalt road surfaces and concerns itself with the proper systematic methods of deep-failure repair operations. The program also includes equipment and personnel requirements, recommended safety and failure marking practices, and a step-by-step procedure of the repair of various deep-failure situations with heavy machinery.)

4. Films

   a. *Asphalt Emulsion Spray Applications.* Color, 23 minutes, 16mm, The Asphalt Institute, 1980. Available from The Asphalt Institute, Asphalt Institute Building, College Park, Maryland 20740, 301/277-4258. Order No. VA-1.

      (NOTE: This film describes and demonstrates [1] what an asphalt emulsion is, [2] pavement surface treatments with asphalt emulsion and aggregates, [3] the steps to be followed for optimal results from emulsion surface treatments, [4] fog sealing, and [5] the universal applicability of emulsion spray applications. The film's narration and graphics are simple and free from quantitative information and complex specifications; however, the film refers viewers to the information contained in the 1979 Asphalt Institute publication, *A Basic Asphalt Emulsion Manual* [MS-19], one copy of which is packaged with each copy of the motion picture. Suitable for showing to all concerned with spray applications and surface treatments using asphalt emulsions.)

   b. *Asphalt Through the Ages.* Color, 16mm, 12 minutes, The Asphalt Institute. Available from The Asphalt Institute, Asphalt Institute Building, College Park, Maryland 20740, 301/277-4258. Order No. VA-2.

      (NOTE: This film, through imaginative animation techniques and actual photography, follows the use of asphalt from ancient times in the Middle East to present-day applications in building materials, water control, and its major use, asphalt highways.)

   c. *Burns.* Color, 14 minutes, 16mm, National Medical Audiovisual Center, 1965. Available from the University of Montana, Instructional Materials Service, Missoula, Montana 59812, 406/243-5976.

      (NOTE: This film helps prepare the individual to give emergency assistance to the injured when trained medical help is unavailable. This film gives basic facts about first-, second-, and third-degree burns and helps establish priorities for treatment of burn victims. It also shows how to treat thermal, electrical, and chemical burns and explains the difference between them. The film concludes with follow-up care for burn victims.)

SUGGESTED ACTIVITIES

d. *Burns: First Aid Treatment.* Color, 19 minutes, 16mm, Oxford Films, Inc., 1978. Available from Louisiana State University Film Library, 118 Himes Hall, Instructional Resource Center, Baton Rouge, Louisiana 70737, 506/388-1135.

(NOTE: This film teaches first aid for burn injuries by dramatizing common burn accidents. Simple rules of treatment for first, second-, and third-degree burns are discussed, as well as rules for chemical and electrical burns. The easy but critical first-aid measures depicted can minimize the chance of serious disability and save lives.)

e. *Shock.* Color, 14 minutes, 16mm, U.S. Department of Health, Education and Welfare, 1965. Available from University of Montana, Instructional Materials Service, Missoula, Montana 59812, 406/243-5976.

(NOTE: This film helps prepare the individual to give emergency assistance to persons who are or may be suffering from shock when trained medical help is unavailable. Defines shock, lists instances when shock may occur, symptoms of shock, and countermeasures against shock; it also lists three lifesaving steps to take at the time of disaster.)

5. Booklet--*Asphalt Pocketbook of Useful Information.* The Asphalt Institute. Available for $2.50 per copy from The Asphalt Institute, Asphalt Institute Building, College Park, Maryland 20740, 301/277-4258. Order No. MS-6.

6. Asphalt paving calculators. Available for $1.00 each, from Training Department, Barber-Greene, 400 North Highland Avenue, Aurora, Illinois 60507, 312/859-2200.

B. Provide students with objective sheet.

C. Provide students with information, assignment, and job sheets.

D. Discuss unit and specific objectives.

E. Discuss information and assignment sheets.

F. Demonstrate and discuss procedures outlined in job sheets.

G. Provide alternate jobs if job sheets are not practical.

H. Give students an overview of asphalt distributor operation. Include circulating and heating process; how weather factors and humidity affect the success of the operation; curing; and traffic control.

I. Stress the danger of fires, explosions, and burns when working with asphalt cutback and emulsion materials.

J. Review first-aid treatment for burns in your state department of transportation safety manual.

SUGGESTED ACTIVITIES

K. Invite resource person to demonstrate first-aid techniques for burns and shock.

L. Invite resource person to discuss asphalt distributor operations.

M. Arrange a field trip to observe a distributor operation.

N. Review traffic control devices.

O. Discuss characteristics of different types of materials.

P. Review asphalt operations.

Q. Give test.

II. Instructional materials

A. Objective sheet

B. Suggested activities

C. Information sheet

D. Assignment sheets

1. Assignment Sheet #1--Complete a Safety Test on Asphalt Distributors

2. Assignment Sheet #2--Distinguish Between Cutback and Emulsion Materials

E. Answers to assignment sheets

F. Job sheets

1. Job Sheet #1--Perform Prestart Inspection and Maintenance Procedures on an Asphalt Distributor

2. Job Sheet #2--Service an Asphalt Distributor

3. Job Sheet #3--Light Burners, Circulate Material, and Shut Down Burners

4. Job Sheet #4--Perform Tank Operations on an Asphalt Distributor

5. Job Sheet #5--Spray a Section of Roadway

G. Test

H. Answers to test

III. Unit references

A. *Bituminous Construction Handbook.* Aurora, Illinois: Barber-Greene Company, 1979.

B. Nichols, H. L., Jr. *Moving the Earth,* 3rd ed. Greenwich, Connecticut: North Castle Books, 1976.

SUGGESTED ACTIVITIES

C. *Black-Topper Operation, Maintenance, and Safety Manual.* Oregon, Illinois: E.D. Etnyre & Co., 1972.

D. *Distributor Model RRH Instructions and Parts List.* Minneapolis, Minnesota: Roscoe Manufacturing Company.

ASPHALT DISTRIBUTOR
UNIT II

INFORMATION SHEET

I. Terms and definitions

A. Asphalt distributor--Truck-mounted material tank and spray bar used to apply liquid asphalt or other liquid materials at an even spread and uniform rate (Figures 1 and 2)

EXAMPLES:

FIGURE 1

SIDE VIEW

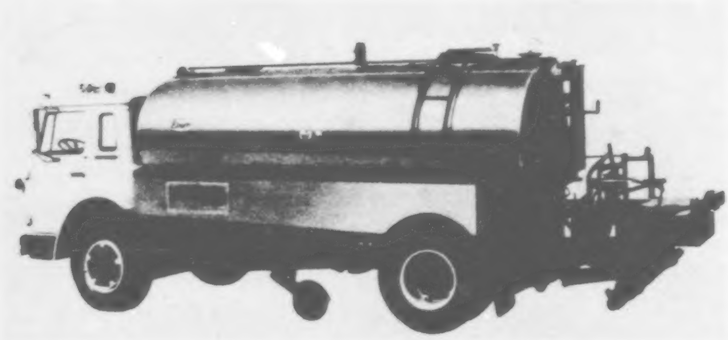
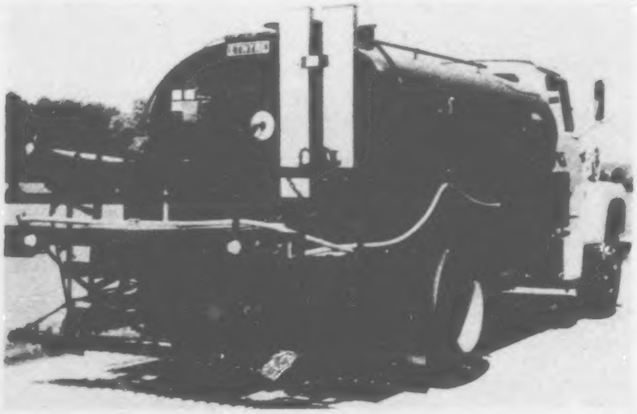


FIGURE 2

REAR VIEW



Figures 1 and 2 courtesy of E.D. Etnyre & Company, Oregon, Illinois.

INFORMATION SHEET

B. Tack coating--Applying liquid asphalt to an existing paved surface to provide a bond between existing surface and material to be laid

C. Prime coating--Applying low-viscosity liquid asphalt directly on a finish grade before wearing surface is applied

D. Tacky--Sticky

E. Course--Layer of material

F. Armor coat (seal course)--Protective sealing layer

G. Asphalt cement--Solid asphalt material

H. Cutback--Asphalt cement combined with a petroleum distillate such as gasoline, kerosene, diesel, or naphtha to make liquid asphalt

EXAMPLES: Rapid curing--RC 250, RC 800, RC 3000
Medium curing--MC 30, MC 70, MC 250, MC 800, MC 3000
Slow curing--SC 70, SC 250, SC 800, SC 3000

(NOTE: RC cutbacks are highly volatile and must be handled with extreme caution.)

I. Emulsifying agent--Chemical that enables asphalt oil and water to mix

(NOTE: Asphalt material and water will not mix. The emulsifying agent enables them to mix by suspending the asphalt material in the water just as dirt or grease is suspended in soapy water.)

J. Emulsion--Asphalt material suspended in water and an emulsifying agent such as soap or chemicals

EXAMPLES: Rapid setting--RS-1, RS-2 and RS-2K, RS-3K, CRS-1, CRS-2
Medium setting--MS-2 and SM-K, CM-K, CMS-1
Slow setting--SS-1, SS-1h and SS-K, SS-Kh

K. Vehicle--Material used to change asphalt cement to a liquid state

L. Evaporate--To reduce liquid content by heat

M. Break--To reduce liquid content by chemical action

N. Volatility--Tendency to explode

O. Hydrostatic drive--Drive that uses hydraulic pump controls

P. Engine drive--Drive that uses manual pump controls

Q. Viscosity--Resistance of a liquid to flow

(NOTE: Viscosity is usually related to thickness or weight, as water flows more rapidly than syrup.)

INFORMATION SHEET

R. Grade--Indication of viscosity; proportion of cutback or emulsifier mixed with asphalt cement

S. cfm--Cubic feet per minute; a standard performance or capacity measurement for compressors

T. Flash point--Lowest temperature to which material may be safely heated without danger of instantaneous flash in the presence of an open flame

U. Loading temperature--Temperature at which viscosity is low enough for material to flow

V. Spraying temperature--Temperature at which material will spray and adhere correctly

EXAMPLES:

GRADE	FLASH POINT	LOADING TEMP.	SPRAYING TEMP.
MC 30	100+	50-170	70-145
MC 800	150+	170-210	180-255

(NOTE: All temperatures are in °F.)

II. Key factors in effective asphalt distributor operation

A. *Even* distribution of material

B. Clean spray bar and nozzles

C. Prevention of fires

D. Avoidance of burns

III. Uses of an asphalt distributor in highway maintenance (Job Sheet #5)

A. Priming or tack coating

B. Dilute or fog sealing

C. Making road mix material

D. Sealing concrete

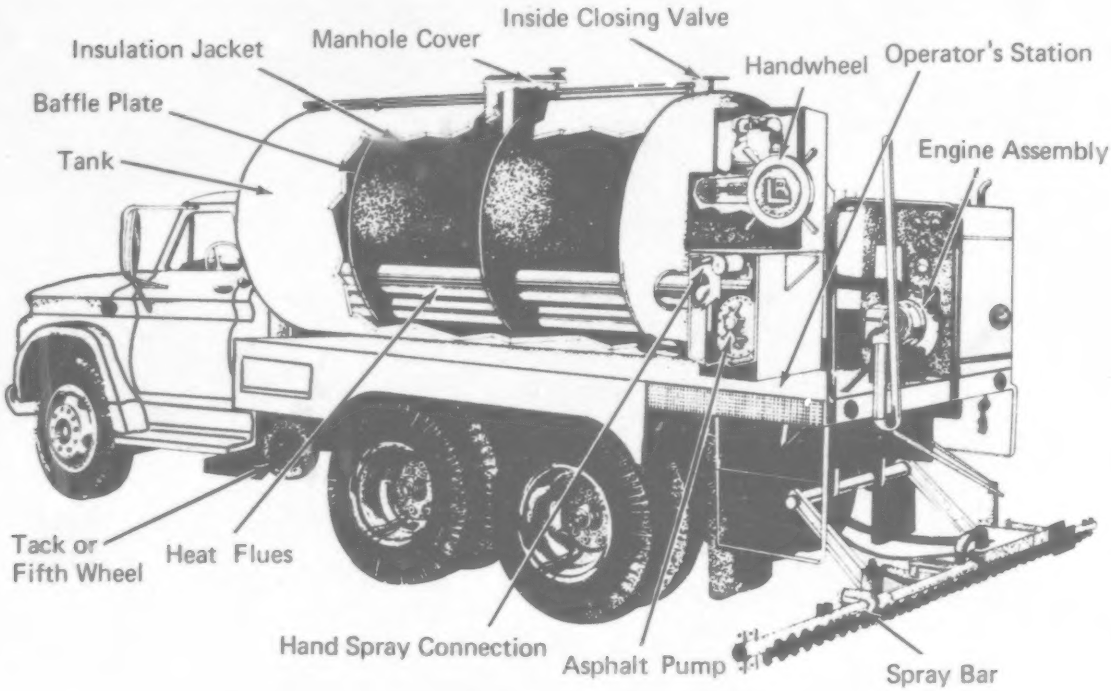
E. Wetting dry or dusty soil

INFORMATION SHEET

IV. Parts of a typical asphalt distributor (Figure 3)

(NOTE: Not shown is a tank that holds diesel fuel for cleaning and flushing the distributor.)

FIGURE 3


Inside Closing Valve
Manhole Cover
Insulation Jacket
Handwheel
Operator's Station
Baffle Plate
Tank
Engine Assembly
Tack or Fifth Wheel
Heat Flues
Hand Spray Connection
Asphalt Pump
Spray Bar

V. Characteristics of hydrostatic drive and characteristics of engine drive (Job Sheet #2)

A. Hydrostatic drives

1. PTO drives pump
2. Hydraulic control regulates pressure
3. Pump controlled from cab
4. One-person operation
5. Unit holds distribution at constant rate when truck speed varies

B. Engine drives

1. Gasoline engine drives pump

INFORMATION SHEET

2. Throttle regulates pressure
3. Pump controlled from operator's station at rear of tank
4. Two-person operation
5. Truck speed must be held constant for even distribution

VI. Functions of controls on a typical asphalt distributor

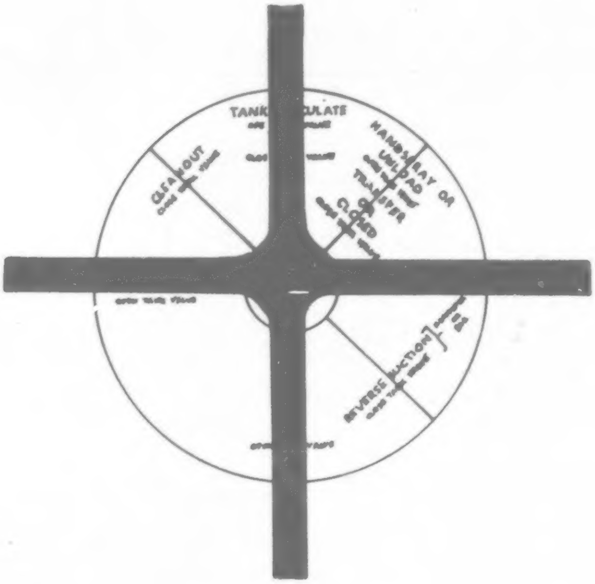
(NOTE: The names of controls and functions vary with the manufacturer, but all distributors have these basic controls.)

A. Quadrant selector--Opens and closes valves for tank and spray operation (Figure 4)

(NOTE: The quadrant selector is located on the rear of the tank and may be a handwheel or a lever. The handle is turned so that an indicator lines up with the desired operation.)

EXAMPLE:

FIGURE 4



B. Tank valve or inside closing valve--Opens and closes tank valves to hold or release material

(NOTE: Location of tank valve varies with the manufacturer.)

INFORMATION SHEET

C. Bitumeter gauge--Determines amount of asphalt distributed at a given truck speed

(NOTE: On an engine-driven model, the gauge has two hands: a black one and a red one. The black one is driven by the tack wheel. The red one is set by hand to the desired asphalt coverage. As the truck moves forward, the black hand moves around the dial until it is in line with the red hand. On a hydrostatic-drive model, adjustment is automatic.)

D. Pump tachometer--Registers material sprayed in gallons per minute (gpm)

(NOTE: May be located in cab or on rear engine.)

E. PTO (hydrostatic drive)--Drives pump

F. Air controls (optional)--Cab controls for manual operations on standard equipment

EXAMPLES: Spray bar ON-OFF, bar LIFT/LOWER, bitumeter wheel RAISE/LOWER

(NOTE: Air controls are mounted to the left or right of the steering column.)

G. Diesel tank valves--Drain diesel fuel into pump or through spigot

(NOTE: Diesel fuel is used to clean nozzles and equipment.)

VII. Materials used in asphalt distributors

(NOTE: Tank must be cleaned *thoroughly* before changing from one material to another.)

A. Asphalt cutback--Used for mixing materials, crack sealing, and armor (seal) coating

(NOTE: Cutback must be heated from 285°F to 350°F for proper application. There are many types of asphalt. Different operations require different grades and viscosities. The type of asphalt for each job is specified by the engineer in charge.)

B. Emulsion--Water and asphalt mixture used for tacking, mixing materials, and armor coating

C. Water--Used to wet down extremely dry or dusty surfaces

D. Linseed oil--Used to seal concrete

INFORMATION SHEET

VIII. Characteristics of cutback and emulsion materials (Assignment Sheet #3)

CHARACTERISTIC	CUTBACK	EMULSION
Vehicle	Petroleum distillate	Water and emulsifier
Liquid content reduction	Evaporates	Breaks, then evaporates
Volatility	Low to High	Low
Operating temperature	105°F to 350°F	150°F to 175°F (must not reach boiling point)

IX. Safety precautions for operating an asphalt distributor (Assignment Sheet #1; Job Sheets #1, #2, and #5)

A. Read operator's manual thoroughly: know your machine

B. Study departmental safety manual on asphalt distributors and burn treatment

C. Use insulated gloves to prevent burns when handling spray bar, sections, or hoses

D. Wear loose-fitting clothing

(NOTE: You should be able to remove clothes quickly in case of fire.)

E. Secure all pipe and hose connections before operating valves

(NOTE: Leaks may spray hot asphalt on other personnel.)

F. Be sure a dry-chemical fire extinguisher and first-aid kit are ready for use

G. Remove fire extinguisher from truck and set it a safe distance away before beginning any operation

(NOTE: If the truck catches fire, you may not be able to get to the extinguisher if it is in the truck.)

H. Stand in a place where you will be protected from accidental opening of spray-bar nozzles

I. Keep unit clean

J. Perform all suggested maintenance and inspection procedures

K. Keep as far away as possible from hot asphalt

INFORMATION SHEET

L. Hold hand spray gun in proper position so as not to spray others

M. Be especially careful while driving the unit *when tank is not completely full*

(NOTE: Ballast plates inside the tank are normally designed only to reduce movement forward or backward. If you make a sudden turn, the material sloshing from side to side my cause the truck to tip over.)

N. Clean distributor *thoroughly* before changing materials

O. Do not heat or load material over 200°F if moisture is present in tank

(NOTE: This is very important when changing from emulsions to cutbacks. If moisture is present in the tank, or if it may be present in the spray bar or circulating system, allow a small portion of hot material to circulate in the bar before filling the tank. At higher temperatures, moisture will cause the material to foam, and fire is likely.)

P. Be aware of other workers

Q. Keep alert

X. Procedures for working effectively with spreader

(NOTE: The distributor operator and the spreader operator work together to lay a perfect armor coat. Cooperation is essential to an effective and efficient operation. The distributor must stop and shut down when the spreader stops, and operators must keep the distance between the two units as short as possible.)

A. Watch spreader in rearview mirror

B. Be prepared to stop when spreader stops

C. Drive in gearshift range and at speed spreader operator selects

D. Slow down if spreader gets too far behind

(NOTE: If the distributor is too far ahead, the asphalt will lose the tack required for the chips to stick, and the asphalt will be wasted. This is especially true in hot weather. Additionally, if there is too much distance between the two units, traffic will pull in between them, spoiling the tack and making ruts in the new surface.)

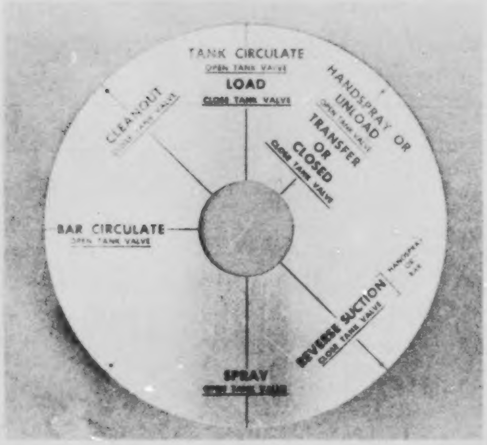
E. Raise tack wheel and back up to line of aggregate when spreader stops; resume spraying, but do not overlap

INFORMATION SHEET

XI. Operating functions (Figure 5; Job Sheet #4)

(NOTE: The following operating functions are common to all distributors, although the terms may differ. Each function requires its own pump speed, and this requirement varies with the manufacturer. Follow manufacturer's instructions.)

FIGURE 5


TANK CIRCULATE
OPEN TANK VALVE
LOAD
CLOSE TANK VALVE
HANDSPRAY OR UNLOAD
OPEN TANK VALVE
TRANSFER OR CLOSED
CLOSE TANK VALVE
CLEANOUT
BAR CIRCULATE
OPEN TANK VALVE
REVERSE SUCTION
CLOSE TANK VALVE
HANDSPRAY OR BAR
SPRAY
OPEN TANK VALVE

Courtesy of Roscoe Manufacturing.

A. Stirring material

EXAMPLE: Tank circulate

(NOTE: Stirring or circulating material in the tank ensures even heating.)

B. Heating spray bar and nozzles

EXAMPLE: Bar circulate

(NOTE: Spray bar and nozzles must be heated before spraying so that material will flow through them without cooling and hardening.)

C. Spraying oil through nozzles

EXAMPLE: Spray

D. Emptying bar

EXAMPLE: Reverse suction

(NOTE: The bar is emptied for transporting, for hand spraying, or while machine is shut down so that material will not cool and harden in the bar. At the end of the job, bar is usually emptied by spraying out remaining material, and then flushing with diesel fuel.)

INFORMATION SHEET

E. Hand spraying

EXAMPLE: Hand spray or unload

(NOTE: The hand sprayer is used for sealing cracks and filling potholes.)

F. Pumping material from oil delivery truck to storage tank

EXAMPLE: Transfer or closed

(NOTE: Material is transferred from supply source to storage, bypassing distributor tank.)

G. Emptying tank

EXAMPLE: Hand spray or unload

(NOTE: This function drains the circulating system and spray bar. Material is put into storage tanks each evening, then reheated by a heating unit called a *booster,* and pumped back into the distributor the next morning.)

H. Cleaning tank

EXAMPLE: Clean out

(NOTE: After each use, circulating system, tank, and bar are flushed and cleaned with diesel fuel. The pump and spray bar are filled with diesel to prevent buildup of material.)

XII. Safety rules for operating burners (Assignment Sheet #1; Job Sheet #3)

(NOTE: Keep thinking safety so you can keep working safely.)

A. Park distributor into wind when heating material

B. Use a torch, not a match or lighter, to ignite the burner

C. Before lighting burners, be sure flues are covered with at least 6 inches of material the full length of tank

(CAUTION: Failure to have at least 6 inches of material in the flues can cause an explosion.)

D. Light inside burner first

(CAUTION: Do not reach across a lit burner to reignite the inside burner.)

E. Do not light burners before they are properly generated

(NOTE: A properly generated burner will burn with a clear reddish-blue flame; an improperly generated burner will discharge raw gases and will burn with a reddish flame.)

INFORMATION SHEET

F. Never light burners immediately after they accidentally blow out

(NOTE: Allow flues to ventilate before reigniting. Accumulated gas may explode.)

G. Do not operate burners unattended or in a confined area

H. Never travel with burners lit

I. Be certain burners are *off* before spraying

J. Circulate material while heating it

(CAUTION: Never heat material without circulating it.)

K. Do not heat material above manufacturer's recommended temperature

XIII. Guidelines for effective distributor operation (Job Sheet #5)

(NOTE: The most important requirement for efficient operation is a clean machine. Many failures in the field are due to the equipment having so much excess road oil and dirt on it that ordinary adjustments and lubrication are difficult and often neglected.)

A. Perform all prestart inspection and maintenance procedures

B. Know and follow manufacturer's recommendations

C. Keep your eye on spreader operator

D. Be sure surface to be sprayed is clean and dry

(NOTE: Good adhesion is your responsibility. Check the surface for mud and grass tracked on after the area has been swept.)

E. Use correct nozzles and spray-bar height for job conditions

F. Be sure all nozzles on spray bar have the same size opening

G. Check bars and nozzles frequently

(NOTE: Use the waiting time while the spreader loads to check nozzles. Clean any plugged nozzles.)

H. Adjust spray bar so that nozzles, not bar, are at recommended height from ground

I. Know proper sequences for burner operation and spray operation

J. Shoot center of road first

(NOTE: The center is sprayed first so that the joint is not in the driving track. The joint will leave a slightly raised area that can throw a car off the road, especially in icy conditions. Sight the center of the truck on the center line of the roadway.)

INFORMATION SHEET

K. Shoot so that left side of distributor is near the aligned side when possible

(NOTE: The truck driver and spray operator's stands are on the left or sight side. Blind side distribution is sometimes necessary, but it should be kept to a minimum.)

L. Spray in direction of traffic flow

M. Keep red and black indicator hands on bitumeter gauge aligned

N. Back up to starting point on second (and following) pass rather than turning around

O. Clean inside of tank thoroughly before changing type of material

(NOTE: If any old material remains in the tank, it will interfere with effective distribution of the new material. For example, AC asphalt has to be heated to over 300°F before it becomes liquid. Emulsions are usually heated to between 150°F and 175°F. If any asphalt is left in the tank when emulsion is heated, it will remain solid and will plug the pump and nozzles. If emulsion is left in the tank when MC asphalt is heated to 300°F, the emulsion will separate and foam over the top of the distributor, causing fire and burn hazards.)

P. Raise tack wheel when transporting or backing up

(CAUTION: Never back up the truck with the tack wheel down.)

Q. On second pass, rotate end nozzle to spray parallel to road

(NOTE: Rotating the end nozzle will leave a thick coat on the joint to ensure a good seal.)

XIV. Factors that determine rate of spray

(NOTE: The type and amount of material distributed are determined by the type of operation, road conditions, and materials.)

A. Temperature

B. Pressure

C. Spray-bar height

D. Road speed

XV. Procedures for uniform material distribution (Job Sheet #5)

(NOTE: It is *essential* that the distributor be capable of spreading the material evenly over the surface.)

A. Maintain uniform temperature

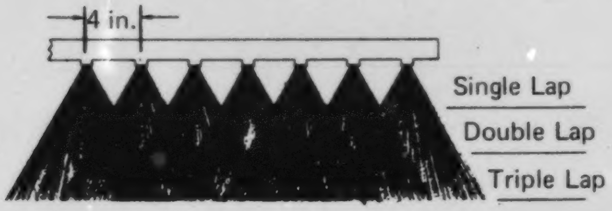
INFORMATION SHEET

B. Maintain uniform pressure on all spray nozzles

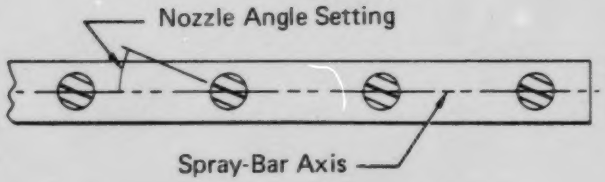
(NOTE: The spray from each nozzle must be uniform and set at the proper angle with the spray bar, according to the manufacturer's instructions. Nozzle openings must be the same size and free of dirt or hard asphalt. Spray fans must not interfere with each other and must overlap for complete and even distribution. See Figure 6.)

FIGURE 6

Proper Spray Fan and Nozzle Angle



PERFECT TRIPLE LAP



C. Maintain spray bar at proper height above road surface

(NOTE: Proper height varies according to manufacturer. See operator's manual.)

D. Determine and maintain uniform road speed

XVI. Steps in a penetration operation (Job Sheet #5)

(NOTE: A penetration operation [also called a *chip and seal operation, surface treatment, seal course,* or *armor coating*] is a sprayed asphalt layer with an aggregate cover one stone deep.)

A. Grading--Clearing brush and grass off shoulder

B. Sweeping--Removing all loose material

INFORMATION SHEET

C. Oil application--Spreading asphalt oil or emulsion to bond surface course

D. Aggregate application--Laying or spreading clean crushed stone (chips), crushed gravel, or sand

E. Rolling--Compacting, embedding, and sealing aggregate

F. Broom dragging--Redistributing aggregate

(NOTE: Broom dragging is used when the distribution is uneven. It tends to shift the smaller chips to the bottom and keep larger chips from sticking, and it turns the asphalted side up so that the wheels of passing traffic pick it up. Broom dragging should be held to a minimum.)

ASPHALT DISTRIBUTOR
UNIT II

ASSIGNMENT SHEET #1--COMPLETE A SAFETY TEST ON ASPHALT DISTRIBUTORS

NAME ______________________________ SCORE ______________

Fires, explosions, and burns are an ever-present danger to operators of asphalt distributors. Operators must be constantly alert and cautious. The material itself and the burner fuels are flammable, and during some steps in operation, both can explode. Hot asphalt can cause mild to severe burns. Review Information Sheet, Sections IX and XII, and complete the following test.

A. What kind of protective clothing should you wear?

1. ____
2. ____

B. What precaution should you remember regarding the flues? ______________________

____

C. What precautions should you take regarding temperature?

1. ____
2. ____

D. Where should you position yourself for your own safety?

1. ____
2. ____

E. What precautions can you take to protect other people on the site?

1. ____
2. ____

F. What precautions should you take when traveling?

1. ____
2. ____

G. What safety precautions should you consider when spraying?

1. ____
2. ____

ASSIGNMENT SHEET #1

H. What precautions should you take regarding pipe and hose connections? ______________

____

I. What type of fire extinguisher should you have? ______________________

J. Where should fire extinguisher be placed during operation? ______________

____

K. Are burners on or off when spraying? ______________________

L. Which burner do you light first? ______________________

M. What do you use to light the burner? ______________________

N. In your opinion, what are the three most important safety precautions to remember?

1. ____
2. ____
3. ____

ASPHALT DISTRIBUTOR
UNIT II

ASSIGNMENT SHEET #2--DISTINGUISH BETWEEN CUTBACK AND EMULSION MATERIALS

NAME ______________________________ SCORE ______________

It is very important for the operator to be able to distinguish emulsions from cutback materials. Confusion of the two can delay operations and cause hazards. If cutback is treated as emulsion, it will clog the spray bar and nozzles. If emulsions are heated to the temperature of cutbacks, they can boil over and ignite.

Remember: Never mix cutback and emulsion. Before materials are changed, the tank, spray bar, nozzles, and hoses must be *thoroughly* cleaned.

Distinguish between cutback and emulsion materials. Write a "C" in the blanks before cutback materials and an "E" in the blanks before emulsions.

_____A. MC 800

_____B. RS-1, RS-2

_____C. Uses kerosene vehicle

_____D. CMS-1

_____E. Has high volatility

_____F. Designated as "slow setting"

_____G. Breaks, then evaporates

_____H. Operating temperature is 150°F to 175°F

_____I. RC 250

_____J. Designated as "medium curing"

_____K. Has water and emulsifier vehicle

_____L. Evaporates

_____M. Has low volatility

_____N. SS-1, SS-1h

_____O. RS-2K, RS-3K

_____P. MC 30

_____Q. CRS-2

ASPHALT DISTRIBUTOR
UNIT II

ANSWERS TO ASSIGNMENT SHEETS

Assignment Sheet #1

A. 1. Use insulated gloves to prevent burns when handling spray bar, sections, or hoses

2. Wear loose-fitting clothing

B. Before lighting burners, be sure flues are covered with at least 6 inches of material

C. 1. Do not heat material above manufacturer's recommended temperature

2. Do not heat or load material over 200°F if moisture is present in tank

D. 1. Stand in a place where you will be protected from accidental opening of spray-bar nozzles

2. Keep as far away as possible from hot asphalt

E. 1. Be aware of other workers

2. Hold hand spray gun in proper position so as not to spray others

F. 1. Never travel with burners lit

2. Be especially careful while driving the unit *when tank is not completely full*

G. 1. Be certain burners are *off* before spraying

2. Hold hand spray gun in proper position so as not to spray others

H. Secure all pipe and hose connections before operating valves

I. Dry chemical

J. Remove fire extinguisher from truck and set it a safe distance away before beginning any operation

K. Off

L. Inside

M. Torch

N. Evaluated to the satisfaction of the instructor

ANSWERS TO ASSIGNMENT SHEETS

Assignment Sheet #2

A. C

B. E

C. C

D. E

E. C

F. E

G. E

H. E

I. C

J. C

K. E

L. C

M. E

N. E (C may be counted, as SC type has low volatility)

O. E

P. C

Q. E

ASPHALT DISTRIBUTOR
UNIT II

JOB SHEET #1--PERFORM PRESTART INSPECTION AND MAINTENANCE PROCEDURES ON AN ASPHALT DISTRIBUTOR

I. Equipment and materials

A. Asphalt distributor

B. Operator's manual

C. Nozzle wrench

D. Manufacturer's recommended lubricants (including high-temperature grease)

E. Grease gun

F. Shop rags

II. Procedure

(NOTE: Deficiencies should be corrected immediately or reported to the proper authority. Do not operate defective equipment.)

A. Make a walk-around visual inspection for leaks and broken, worn, or missing parts

B. Perform prestart maintenance and inspection on truck

C. Check manufacturer's recommendations for proper lubrication; lubricate where needed

D. Check bolts; tighten if necessary

(NOTE: To prevent leakage, do not tighten any gasketed joints beyond a snug fit.)

E. Drain any testing oil or condensation from circulation system

(NOTE: Be sure to close drain control levers.)

F. Adjust nozzles to approximately 30 degrees

G. Lower spray bar and adjust height according to manufacturer's recommendations and weather conditions

H. Check drive units

1. Engine drive units

a. Start engine

b. Set at fast idle speed

111

  c. Shift transmission to either high or low gear and engage clutch easily

  (NOTE: Make sure pump is free [not "frozen"] and all parts and instruments are in proper working order. However, do not operate the pump for long periods without asphalt to lubricate it.)

  d. Adjust engine speed and transmission speed to regulate pressure at spray bar for proper application rate

2. Hydrostatic drive models
    a. Set brake
    b. Pull up hydraulic control in cab
    c. Push in override control located at rear platform
    d. Start truck engine in neutral
    e. Engage PTO
    f. Carefully pull out override control at rear
    g. Check that pump is free and working easily
    h. Push in rear override control
    i. Push down hydraulic control in cab
    j. Check pump tachometers and controls
    k. Pull up cab control and disengage PTO when finished with check

    (NOTE: Do not operate pump for long periods without asphalt to supply lubrication.)

I. Check all valves for tightness; lubricate regularly

(NOTE: Turn valves and check for striking or resistance.)

J. Check swing joints for proper positioning to allow unobstructed flow; adjust if necessary

K. Check spray-bar gaskets for wear; replace if necessary

(NOTE: Do not tighten caps more than about one-quarter turn at a time; tighten just enough to stop leaks. Too much compression will not allow joints to move easily and will shorten life of gaskets. The proper time to snug up gaskets and joints is when the machine has been run and spray bar is warm.)

JOB SHEET #1

L. Check nozzles for dirt and damage; clean and replace as needed

M. Check nozzle angle; adjust as needed

N. Check gauges for dirt and breakage

O. Inspect and clean strainers

1. Fuel strainer screens–Located in fuel-line needle valves at rear of distributor (may vary with different manufacturers)

2. Manhole screen–Basket-type strainer located within manhole

3. Loading screen–Located at fill-line connector

   (NOTE: Keep dirt, rocks, screws, or nuts out of the fill line. Any foreign matter in the line will seriously damage the rotating parts of the pump.)

P. Check tack wheel for dirt and wear; clean as necessary; replace any worn parts immediately

ASPHALT DISTRIBUTOR
UNIT II

JOB SHEET #2--SERVICE AN ASPHALT DISTRIBUTOR

I. Equipment and materials

  A. Asphalt distributor

  B. Operator's manual

  C. Manufacturer's recommended lubricants, including high-temperature grease

  D. Grease gun, grease sticks

  E. Cleaning solvents

  F. Water

  G. Shop rags

  H. Tools

  I. Nozzle adjusting tool

II. Procedure

(NOTE: Follow departmental preventive maintenance program when servicing equipment. Refer to operator's manual for lubrication chart and for servicing specific components and attachments.)

  A. Visually inspect for leaks and broken, worn, or missing parts

  (NOTE: Major repairs and replacements should be reported to the proper authority and completed by a trained mechanic.)

  B. Check pump for dirt; lubricate if needed

  (NOTE: Grease the pump, packing gland, pump shaft, and idler shaft bushings with high-temperature grease.)

  C. Check burner-nozzle plugs for dirt and scale; clean as needed

  D. Check burner settings; tighten if needed

  E. Check flue shields for wear; replace if necessary

  F. Check thermometer for dirt, cracks, or breakage; clean or replace as needed

  G. Inspect piping system and correct leaks immediately

  H. Check suction piping for loose connections; tighten where needed

  (NOTE: The interior of all piping and sumps must be free of dirt and slugs of asphalt. Hardened asphalt at low spots and in the feed lines and spray bar will plug nozzles and cause uneven application and may block the flow when draining the spray bar.)

ASPHALT DISTRIBUTOR
UNIT II

JOB SHEET #3--LIGHT BURNERS, CIRCULATE MATERIAL, AND SHUT DOWN BURNERS

I. Equipment and materials

- A. Operator's manual
- B. Asphalt distributor
- C. Torch
- D. Loose clothing

II. Procedure

- A. Check that flues are covered with at least 6 inches of material for full length of tank
- B. Open covers on heat exhaust stacks
- C. Check that hand valve at burner is tightly closed
- D. Open supply tank valve only a quarter of a turn so that it may be closed quickly in case of a leak
- E. Apply torch to burner
- F. Open hand valve at burner to full position as soon as burner is lit

  (CAUTION: The burner must be lit before opening hand valve at the burner.)

  (NOTE: Most valves have a built-in bypass and permit only enough gas to escape to operate as a pilot or standby. This bypass hole must be kept open to prevent damage to the gauge and supply lines. After shutdown and before relighting burner, close valve at burner.)

- G. Open supply valve at tank fully and regulate pressure according to operator's manual
- H. Adjust fire with hand valve at burner

  (CAUTION: Do not leave burners unattended. Do not heat material beyond manufacturer's recommended temperature.)

- I. Bring material to desired temperature
- J. Be sure pump is operating at desired speed

  (NOTE: Pump usually operates at 100 gpm to 160 gpm. Check operator's manual.)

JOB SHEET #3

K. When material reaches desired temperature, lower flames on burners until there is just enough heat to maintain correct temperature

L. Follow manufacturer's procedures for circulating material in tank

(CAUTION: Stay clear of rotation drives.)

M. Shut down burners by closing valve at supply tank

(NOTE: Burners will continue to burn until fuel in lines has been burned up.)

(CAUTION: If burners are accidently blown out, allow ventilation before relighting.)

N. Shut hand valve at burner after burner has gone out

O. Shut down circulating pump according to operator's manual

ASPHALT DISTRIBUTOR
UNIT II

JOB SHEET #4--PERFORM TANK OPERATIONS ON AN ASPHALT DISTRIBUTOR

I. Equipment, materials, and personnel

   A. Asphalt distributor

   B. Operator's manual

   C. Insulated gloves

   D. Loose clothing

   E. Torch

   F. Second operator at rear operator's station if needed

   G. Flushing oil or diesel fuel

   H. Storage tank with heated oil to fill tank

   I. Fill and drain hoses

   J. Area for practice spraying (length of roadway, parking lot.)

II. Procedure

   A. Fill tank through manhole

   (NOTE: Tie hose down into manhole to avoid spills.)

   B. Drive to site

   C. Park into the wind

   D. Remove fire extinguisher and place at a safe distance from distributor

   E. Light burners and circulate material in tank according to operator's manual

   F. Clean nozzles with diesel fuel

   G. Check nozzle alignment

   H. Bring temperature and pressure up to manufacturer's specifications

   I. Shut down burners

   J. Run diesel fuel through bar and nozzles until diesel runs clear

JOB SHEET #4

K. Follow operator's manual to perform the following tank operations

1. Circulate material in bar
2. Run oil out of nozzles, turning it on and off until bar and nozzles are heated and material flows evenly
3. Lower tack wheel
4. Spray a length of asphalt
   a. Have a second operator signal when spray is even
   b. Experiment with speed changes to find correct speed

   (NOTE: After spraying, be sure to lift the tack wheel.)
5. Draw material in bar back into tank
6. Hand spray an area

   (CAUTION: Stand clear of spray. Hold gun in proper position. Watch for other personnel. Wear insulated gloves.)
7. Return to yard

   (NOTE: Be sure to return fire extinguisher to truck and to raise tack wheel.)
8. Drain spray bar and circulating system into storage tank
9. Flush bar, circulating system, and tank
10. Secure machine

    (NOTE: Clean asphalt off hands and skin with diesel fuel or hand cleaner.)

ASPHALT DISTRIBUTOR
UNIT II

JOB SHEET #5--SPRAY A SECTION OF ROADWAY

I. Equipment and materials

   A. Asphalt distributor

   B. Operator's manual

   C. Asphalt or emulsion

   D. Gloves

   E. Loose clothing

   F. Engineer's specifications for this operation

II. Procedure

   A. Make a visual inspection and complete preoperation procedures on distributor

   B. Be sure tack wheel is up and proceed to location

   C. Light burners to bring material to desired temperature; circulate material

   (NOTE: Do not exceed recommended pump speed or temperature. Be sure to open heat exhaust covers.)

   (CAUTION: There is danger of fire and explosion. Use extreme caution.)

   D. Put up necessary warning signs and devices

   E. Inspect area for obstacles and personnel

   F. Check engineering instructions or operator's manual for required application rate

   G. Set bitumeter gauge

   H. Adjust nozzles to correct angle

   I. Check pressure and temperature; when they are at the recommended levels, shut down burners, and allow flame to burn out

   J. Lower tack wheel

   K. Switch selector valve to SPRAY, according to operator's manual

   L. Bring truck up to recommended speed as quickly as possible

JOB SHEET #5

M. As you are getting up to speed, distribute or spray by engaging control lever or button according to operator's manual

(NOTE: Watch spreader operator in rearview mirror.)

N. Start in center, using center line as a guide

(NOTE: Watch spreader in rearview mirror.)

O. Spray designated section

P. Stop spraying operation according to operator's manual

Q. Raise tack wheel

R. Pull forward until you are far enough away from fresh asphalt to back up

S. Back distributor alongside fresh layer until you reach point where spray operation started

(NOTE: If section is miles long, turn around and drive back.)

T. Lower the tack wheel

U. Repeat procedure until operation is completed

V. Shut down equipment properly

W. Do not remove traffic control or warning devices until asphalt has cured enough to be traveled on

ASPHALT DISTRIBUTOR
UNIT II

TEST

NAME ____________________ SCORE __________

1. Match terms associated with asphalt distributors to their correct definitions. Write the correct numbers in the blanks. Terms and definitions are continued on the following page.

_____ a. Protective sealing layer

_____ b. Resistance of a liquid to flow

_____ c. Drive that uses hydraulic pump controls

_____ d. Sticky

_____ e. Applying liquid asphalt to an existing paved surface to provide a bond between existing surface and material to be laid

_____ f. Cubic feet per minute; a standard performance or capacity measurement for compressors

_____ g. Truck-mounted material tank and spray bar used to apply liquid asphalt or other liquid materials at an even spread and uniform rate

_____ h. Drive that uses manual pump controls

_____ i. Layer of material

_____ j. Applying low-viscosity liquid asphalt directly on a finish grade before wearing surface is applied

_____ k. Indication of viscosity; proportion of cutback or emulsifier mixed with asphalt cement

_____ l. To reduce liquid content by chemical action

_____ m. Chemical that enables asphalt oil and water to mix

_____ n. Material used to change asphalt cement to a liquid state

_____ o. Solid asphalt material

1. Viscosity
2. Asphalt distributor
3. Tack coating
4. Hydrostatic drive
5. Tacky
6. Prime coating
7. Course
8. cfm
9. Engine drive
10. Armor coat (seal course)
11. Grade
12. Break
13. Emulsifying agent
14. Asphalt cement
15. Vehicle

TEST

_____p. Asphalt cement combined with a petroleum distillate such as gasoline, kerosene, diesel, or naphtha to make liquid asphalt

_____q. To reduce liquid content by heat

_____r. Asphalt material suspended in water and an emulsifying agent such as soap or chemicals

_____s. Tendency to explode

_____t. Lowest temperature to which material may be safely heated without danger of instantaneous flash in the presence of an open flame

_____u. Temperature at which material will spray and adhere correctly

_____v. Temperature at which viscosity is low enough for material to flow

16. Evaporate
17. Emulsion
18. Cutback
19. Volatility
20. Loading temperature
21. Flash point
22. Spraying temperature

2. State key factors in effective asphalt distributor operation.

a. ____

b. ____

c. ____

d. ____

3. Select from the following list uses of an asphalt distributor in highway maintenance. Write an "X" in the blank before each correct answer.

_____a. Sealing concrete

_____b. Patching concrete

_____c. Making road mix material

_____d. Laying concrete sections

_____e. Wetting dry or dusty soil

_____f. Building up shoulders

_____g. Marking lanes

_____h. Priming or tack coating

_____i. Laying pavement

_____j. Dilute or fog sealing

_____k. Priming concrete

TEST

4. Identify parts of a typical asphalt distributor. Write the correct numbers in the blanks.

_____a. Spray bar

_____b. Tack or fifth wheel

_____c. Insulation jacket

_____d. Handwheel

_____e. Engine assembly

_____f. Heat flues

_____g. Operator's station

_____h. Hand spray connection

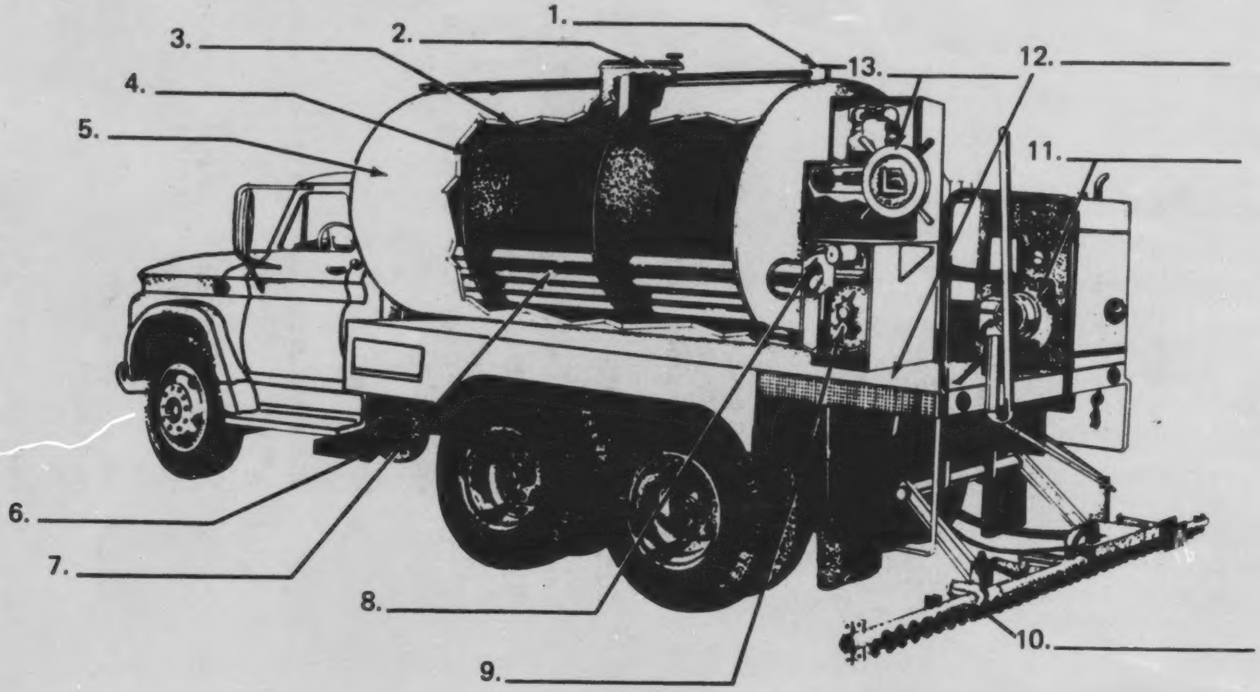
_____i. Baffle plate

_____j. Tank

_____k. Inside closing valve

_____l. Asphalt pump

_____m. Manhole cover



TEST

5. Distinguish between characteristics of hydrostatic drive and characteristics of engine drive. Write an "H" in the blanks before characteristics of hydrostatic drive, and an "E" in the blanks before characteristics of engine drive.

_____a. Pump controlled from operator's station at rear of tank

_____b. Two-person operation

_____c. PTO drives pump

_____d. Truck speed must be held constant for even distribution

_____e. Hydraulic control regulates pressure

_____f. One-person operation

_____g. Unit holds distribution at constant rate when truck speed varies

_____h. Throttle regulates pressure

_____i. Pump controlled from cab

_____j. Gasoline engine drives pump

6. Match controls on a typical asphalt distributor to their correct functions. Write the correct numbers in the blanks.

_____a. Opens and closes tank valves to hold or release material

_____b. Drives pump

_____c. Opens and closes valves for tank and spray operation

_____d. Determines amount of asphalt distributed at a given truck speed

_____e. Cab controls for manual operations on standard equipment

_____f. Registers material sprayed in gallons per minute (gpm)

_____g. Drain diesel fuel into pump or through spigot

1. Bitumeter gauge
2. Quadrant selector
3. Air controls (optional)
4. Tank valve or inside closing valve
5. Pump tachometer
6. PTO (hydrostatic drive)
7. Diesel tank valves

TEST

7. Match materials used in asphalt distributors to their correct uses. Write the correct numbers in the blanks.

______a. Used to wet down extremely dry or dusty surfaces

______b. Used to seal concrete

______c. Used for mixing materials, crack sealing, and armor (seal) coating

______d. Water and asphalt mixture used for tacking, mixing materials, and armor coating

1. Asphalt cutback
2. Water
3. Emulsion
4. Linseed oil

8. Identify characteristics of cutback and emulsion materials. Write the correct answers in the blanks.

Breaks, then evaporates
Low
Low to high
Petroleum distillate
150°F to 175°F (must not reach boiling point)
Water and emulsifier
105°F to 350°F
Evaporates

CHARACTERISTIC	CUTBACK	EMULSION
Vehicle	a. ____________	b. ____________
Liquid content reduction	c. ____________	d. ____________
Volatility	e. ____________	f. ____________
Operating temperature	g. ____________	h. ____________

9. State ten safety precautions for operating an asphalt distributor.

a. ____

b. ____

c. ____

d. ____

e. ____

f. ____

TEST

g. ____________________

h. ____________________

i. ____________________

j. ____________________

10. State four procedures for working effectively with spreader.

a. ____________________

b. ____________________

c. ____________________

d. ____________________

11. Select from the following list asphalt distributor operating functions. Write an "X" in the blank before each correct answer.

_____a. Spraying oil through nozzles

_____b. Lubricating pump

_____c. Hand spraying

_____d. Stirring material

_____e. Filling supply line

_____f. Pumping material from oil delivery truck to storage tank

_____g. Emptying bar

_____h. Emptying tank

_____i. Emptying pump

_____j. Pumping material from storage tank to distributor tank

_____k. Cleaning tank

_____l. Setting quadrant selector

_____m. Heating spray bar and nozzles

12. State seven safety rules for operating burners.

a. ____________________

b. ____________________

c. ____________________

d. ____________________

TEST

e. ______________________________

f. ______________________________

g. ______________________________

13. Select from the following list guidelines for effective distributor operation. Write an "X" in the blank before each correct answer.

_____a. Lower tack wheel when transporting or backing up

_____b. Back up to starting point on second (and following) pass rather than turning around

_____c. Keep pressure at 160 psi

_____d. Adjust spray bar so that nozzles, not bar, are at recommended height from ground

_____e. Shoot so that right side of distributor is near aligned side when possible

_____f. Use large-sized nozzles on ends, smaller nozzles in center

_____g. Use correct nozzles and spray-bar height for job conditions

_____h. Raise tack wheel when transporting or backing up

_____i. Shoot shoulders first

_____j. Operate from blind side when possible

_____k. Check bars and nozzles frequently

_____l. Wear tight-fitting clothes

_____m. Know proper sequences for burner operation and spray operation

_____n. Know and follow manufacturer's recommendations

_____o. Be sure all nozzles on spray bar have the same size opening

_____p. Keep red and black indicator hands on bitumeter gauge aligned

_____q. Shoot so that left side of distributor is near the aligned side when possible

_____r. Keep hydraulic pressure constant

_____s. Adjust spray bar so that bar, not nozzles, is at recommended height from ground

_____t. Spray in direction of traffic flow

TEST

_____ u. Be sure surface to be sprayed is clean and dry

_____ v. Keep your eye on spreader operator

_____ w. Heat emulsions to 300°F

_____ x. Clean inside of tank thoroughly before changing type of material

_____ y. Flush tank with water each use

_____ z. On second pass, rotate end nozzle to spray parallel to road

14. Select from the following list factors that determine rate of spray. Write an "X" in the blank before each correct answer.

_____ a. Nozzle adjustment

_____ b. Spray-bar height

_____ c. Type of material

_____ d. Type of operation

_____ e. Temperature

_____ f. Burner operation

_____ g. Pressure

_____ h. Road speed

15. State procedures for uniform material distribution.

a. ______________________________

b. ______________________________

c. ______________________________

d. ______________________________

16. Arrange in order the steps in a penetration operation. Write a "1" before the first step, a "2" before the second step, and so on.

_____ a. Broom dragging--Redistributing aggregate

_____ b. Sweeping--Removing all loose material

_____ c. Grading--Clearing brush and grass off shoulder

_____ d. Rolling--Compacting, embedding, and sealing aggregate

TEST

_____e. Aggregate application--Laying or spreading clean crushed stone (chips), crushed gravel, or sand

_____f. Oil application--Spreading asphalt oil or emulsion to bond surface course

(NOTE: Test questions 17-19 list the assignment and job sheets. They are an important part of this test. If they have not been completed, check with your instructor.)

17. Complete a safety test on asphalt distributors.

18. Distinguish between cutback and emulsion materials.

19. Demonstrate the ability to

    a. Perform prestart inspection and maintenance procedures on an asphalt distributor.

    b. Service an asphalt distributor.

    c. Light burners, circulate material, and shut down burners.

    d. Perform tank operations on an asphalt distributor.

    e. Spray a section of roadway.

ASPHALT DISTRIBUTOR
UNIT II

ANSWERS TO TEST

1. a. 10
   b. 1
   c. 4
   d. 5
   e. 3
   f. 8
   g. 2
   h. 9
   i. 7
   j. 6
   k. 11
   l. 12
   m. 13
   n. 15
   o. 14
   p. 18
   q. 16
   r. 17
   s. 19
   t. 21
   u. 22
   v. 20

2. a. Even distribution of material
   b. Clean spray bar and nozzles
   c. Prevention of fires
   d. Avoidance of burns

3. a, c, e, h, j

4. a. 10
   b. 6
   c. 3
   d. 13
   e. 11
   f. 7
   g. 12
   h. 8
   i. 4
   j. 5
   k. 1
   l. 9
   m. 2

5. a. E
   b. E
   c. H
   d. E
   e. H
   f. H
   g. H
   h. E
   i. H
   j. E

ANSWERS TO TEST

6. a. 4
   b. 6
   c. 2
   d. 1
   e. 3
   f. 5
   g. 7

7. a. 2
   b. 4
   c. 1
   d. 3

8. a. Petroleum distillate
   b. Water and emulsifier
   c. Evaporates
   d. Breaks, then evaporates
   e. Low to high
   f. Low
   g. 105°F to 350°F
   h. 150°F to 175°F (must not reach boiling point)

9. Answer should include any ten of the following
   a. Read operator's manual thoroughly: know your machine
   b. Study departmental safety manual on asphalt distributors and burn treatment
   c. Use insulated gloves to prevent burns when handling spray bar, sections, or hoses
   d. Wear loose-fitting clothing
   e. Secure all pipe and hose connections before operating valves
   f. Be sure a dry-chemical fire extinguisher and first-aid kit are ready for use
   g. Remove fire extinguisher from truck and set it a safe distance away before beginning any operation
   h. Stand in a place where you will be protected from accidental opening of spray-bar nozzles
   i. Keep unit clean

ANSWERS TO TEST

   j. Perform all suggested maintenance and inspection procedures

   k. Keep as far away as possible from hot asphalt

   l. Hold hand spray gun in proper position so as not to spray others

   m. Be especially careful while driving the unit *when tank is not completely full*

   n. Clean distributor *thoroughly* before changing materials

   o. Do not heat or load material over 200°F if moisture is present in tank

   p. Be aware of other workers

   q. Keep alert

10. Answer should include any four of the following

   a. Watch spreader in rearview mirror

   b. Be prepared to stop when spreader stops

   c. Drive in gearshift range and at speed spreader operator selects

   d. Slow down if spreader gets too far behind

   e. Raise tack wheel and back up to line of aggregate when spreader stops; resume spraying, but do not overlap

11. a, c, d, f, g, h, k, m

12. Answer should include any seven of the following

   a. Park distributor into wind when heating material

   b. Use a torch, not a match or lighter, to ignite the burner

   c. Before lighting burners, be sure flues are covered with at least 6 inches of material the full length of tank

   d. Light inside burner first

   e. Do not light burners before they are properly generated

   f. Never light burners immediately after they accidentally blow out

   g. Do not operate burners unattended or in a confined area

   h. Never travel with burners lit

ANSWERS TO TEST

i. Be certain burners are *off* before spraying

j. Circulate material while heating it

k. Do not heat material above manufacturer's recommended temperature

13. b, d, g, h, k, m, n, o, p, q, t, u, v, x, z

14. b, e, g, h

15. a. Maintain uniform temperature

b. Maintain uniform pressure on all spray nozzles

c. Maintain spray bar at proper height above road surface

d. Determine and maintain uniform road speed

16. a. 6

b. 2

c. 1

d. 5

e. 4

f. 3

17. Evaluated to the satisfaction of the instructor

18. Evaluated to the satisfaction of the instructor

19. Performance skills evaluated to the satisfaction of the instructor

ROLLERS
UNIT III

UNIT OBJECTIVE

After completing this unit, the student should be able to operate various rollers for highway maintenance work safely and effectively. This knowledge will be shown by completing assignment sheets, job sheets, and unit test with a minimum score of 85 percent.

SPECIFIC OBJECTIVES

After completing this unit, the student should be able to

1. Match terms associated with rollers to their correct definitions.
2. Identify types of rollers used in highway maintenance operations.
3. Match types of rollers to their correct highway maintenance operations.
4. State safety rules for operating rollers.
5. Identify parts of a roller.
6. Identify controls on a typical roller.
7. Select from a list maintenance procedures for rollers.
8. State procedures for effective roller operation.
9. Select from a list procedures for operating a vibratory roller.
10. State procedures for operating on slopes.
11. Describe a pneumatic roller operation.
12. Describe a steel-wheel asphalt rolling operation.
13. Demonstrate the ability to
    a. Perform prestart inspection and maintenance on a steel-wheel roller.
    b. Perform prestart inspection and maintenance on a pneumatic roller.
    c. Service a vibratory roller.
    d. Start, warm up, operate, and shut down a roller.
    e. Compact subgrade with a padfoot roller.
    f. Compact asphalt mat with a pneumatic roller.
    g. Compact asphalt mat with a steel-wheel roller.
    h. Compact asphalt mat with a vibratory roller.

ROLLERS
UNIT III

SUGGESTED ACTIVITIES

I. Suggested activities

A. Order materials to supplement unit.

1. Slide/cassette programs

a. *Asphalt Surface Maintenance.* Color, 2 hours, Arkansas State Highway Department. Available from Oklahoma Department of Transportation, 200 Northeast 21st, Oklahoma City, Oklahoma 73105, 405/521-4141. Order code 322-77-1-4.

(NOTE: This slide series comes in four parts. Part one, *Asphalt Surface Care,* describes the patching, leveling, and sealing that needs to be done to maintain asphalt surface. Part two, *Patching Asphalt Surfaces,* explains how to repair potholes, edge failures, broken surfacing, and similar defects. Part three, *Pre-Mix Leveling Operation,* explains how to restore asphalt surfaces to their original shape by filling in depressions, wheel ruts, and other distortions. Part four, *Sealing Asphalt Surfaces,* discusses spot sealing with seal coat or fog seal.)

b. *Pavement Maintenance, #1, #2, #3.* Color, 60 minutes, The Asphalt Institute. Available from The Asphalt Institute, Asphalt Institute Building, College Park, Maryland 20740.

(NOTE: This series shows the maintenance of asphalt roads and the right way to fill cracks.)

2. Films

a. *Techniques for Superior Asphalt Paving.* Color, 28 minutes, 16 mm, Barber-Greene. Available without charge from Barber-Greene, Training Department, 400 North Highland Avenue, Aurora, Illinois 60507, 312/850-2200.

(NOTE: This film is designed to give paving supervisors, job superintendents, operators, and others interested in getting the best possible paver performance on every job a better understanding of the application and operation of modern finishers equipped with hydrostatic power-transmission systems. The film covers all phases of finisher operation from starting the mat to end-of-the-day cleanup and maintenance. It utilizes cartoons to illustrate a number of important do's and don'ts.)

SUGGESTED ACTIVITIES

b. *Rolling Plant-Mixed Asphalt Pavements.* Color, 16 mm, 12 minutes, The Asphalt Institute. Available from The Asphalt Institute, Asphalt Institute Building, College Park, Maryland 20740, 301/277-4258. Order no. VA-7.

(NOTE: This film discusses the recommended procedure for rolling plant-mixed asphalt. The correct use of steel-wheeled, vibratory, and pneumatic-tired rollers is shown in both animation and live sequences.)

3. Booklet--*Safety Manual: Roller Compactor for Operating and Maintenance Personnel,* 1978. Available from Construction Industry Manufacturers Association, 111 East Wisconsin Avenue, Milwaukee, Wisconsin 53202.

4. Operator's manuals for the equipment students will operate

B. Make transparency.

C. Provide students with objective sheet.

D. Provide students with information, assignment, and job sheets.

E. Discuss unit and specific objectives.

F. Discuss information and assignment sheets.

G. Demonstrate and discuss procedures outlined in job sheets.

H. Provide alternate jobs if those in job sheets are not practical.

I. Arrange for field trips for students to observe the following operations.

    1. Asphalt laydown
    2. Blade-laid resurfacing
    3. Vibratory roller operation
    4. Final grading with a steel-wheel roller

J. Review asphalt operation procedures.

K. Give test.

II. Instructional materials

A. Objective sheet

B. Suggested activities

C. Information sheet

SUGGESTED ACTIVITIES

D. Transparency master: TM #1--General Rolling Pattern

E. Assignment sheets

  1. Assignment Sheet #1--Describe a Pneumatic Roller Operation
  2. Assignment Sheet #2--Describe a Steel-Wheel Asphalt Rolling Operation

F. Answers to assignment sheets

G. Job sheets

  1. Job Sheet #1--Perform Prestart Inspection and Maintenance on a Steel-Wheel Roller
  2. Job Sheet #2--Perform Prestart Inspection and Maintenance on a Pneumatic Roller
  3. Job Sheet #3--Service a Vibratory Roller
  4. Job Sheet #4--Start, Warm Up, Operate, and Shut Down a Roller
  5. Job Sheet #5--Compact Subgrade with a Padfoot Roller
  6. Job Sheet #6--Compact Asphalt Mat with a Pneumatic Roller
  7. Job Sheet #7--Compact Asphalt Mat with a Steel-Wheel Roller
  8. Job Sheet #8--Compact Asphalt Mat with a Vibratory Roller

H. Test

I. Answers to test

III. Unit references

A. *Compaction of Asphalt with Vibratory Compactors.* Minneapolis, Minnesota: RayGo, Inc., 1975.

B. *Equipment Operator 3 and 2.* Naval Training Command Rate Training Manual NAVTRA 10640-G. Washington, D.C.: Bureau of Naval Personnel, 1973.

C. *Operator's Manual No. 7200,Tandem Roller.* Galion, Ohio: Galion/Dresser Industries, n.d.

D. *Operator's Manual, No. 7802, Vibratory Roller.* Galion, Ohio: Galion/Dresser Industries, n.d.

E. *Operator's and Service Manual: Pneumatic Roller.* San Antonio, Texas: Ingram Manufacturing Company, 1976.

SUGGESTED ACTIVITIES

F. *Operator's and Service Manual: Three Wheel and Tandem Roller.* San Antonio, Texas: Ingram Manufacturing Company, 1980.

G. *Operator's Manual for Self-Propelled Pneumatic Tire Roller. Models SP-3000 and SP-4000.* Minneapolis, Minnesota: Bros Amhoist, n.d.

H. *Operation and Field Maintenance Manual, Vibratory Compactor Model CC-2.* Stanhope, New Jersey: Dynapac Manufacturing, Inc., 1977.

ROLLERS
UNIT III

INFORMATION SHEET

I. Terms and definitions

- A. Roller--Truck-mounted or portable weighted cylinder(s) used to compact aggregate into liquid asphalt and to compact grades, fills, and asphalt mats
- B. Aggregate (chips)--Crushed rock or gravel screened to sizes for use in road surfaces, concrete, or asphalt mixes
- C. Mix--Liquid asphalt material mixed with fine or coarse aggregate
- D. Tacky--Sticky
- E. Compaction--Pressing material together to increase density
- F. Fill--Soil used for bulk

  (NOTE: Fill may be dirt or combination of dirt and sand, loose rock, or other material.)
- G. Mat--Newly laid asphalt surface; may be hot or cold asphalt mix, several inches thick
- H. Ballast--Heavy material, such as water, sand, or concrete, that has no function in a machine except to increase weight
- I. Breakdown rolling--Initial compaction
- J. Cocoa mat--Fabric of wood fibers that distributes water as a film of moisture over the entire roller surface as it turns against it
- K. Sprinkler system--System that moistens roller to keep hot asphalt from sticking to roller
- L. Scrapers--Blades that clean the rollers
- M. Lift--Thickness of material spread in one layer
- N. Amplitude--Height a vibrating roller travels or bounces
- O. Blade-laid operation--Asphalt material mixed and placed by a motor grader

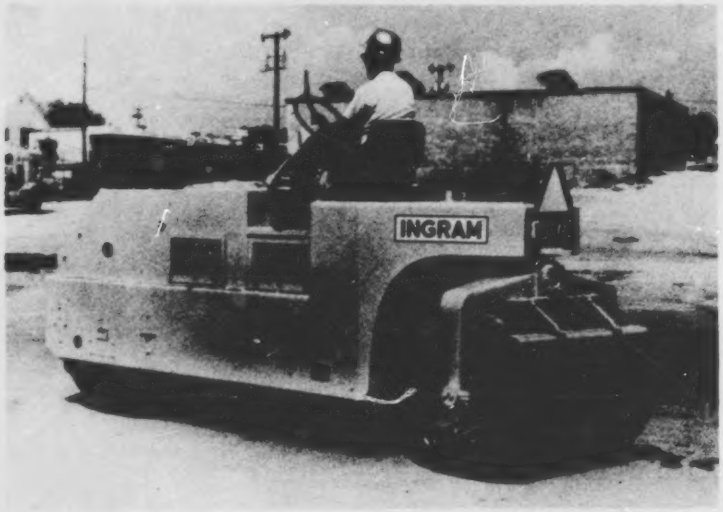
INFORMATION SHEET

II. Types of rollers used in highway maintenance operations (Figures 1-5)

A. Steel-wheel roller (tandem roller) (Job Sheet #7)

(NOTE: The steel-wheel may be tandem or triple axle, three wheeled, or portable with tires and rollers. It comes in many weights and sizes. Depending on model and manufacturer, one wheel drives the roller and the other steers.)

FIGURE 1



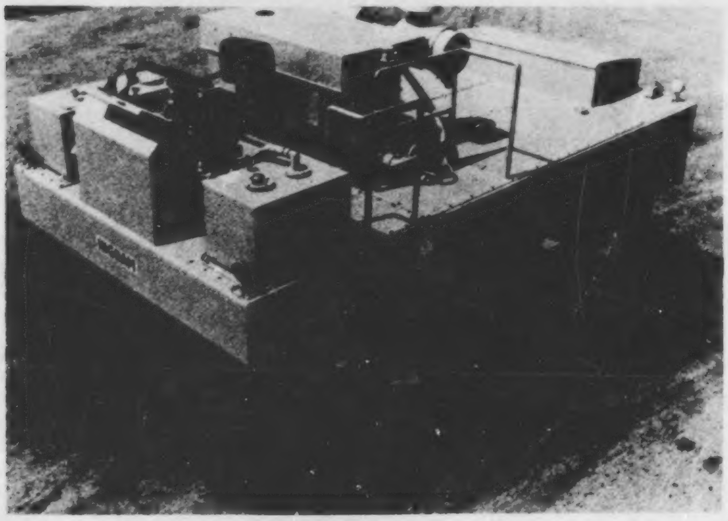
Courtesy of Ingram Mfg. Co.

INFORMATION SHEET

B. Pneumatic roller (Assignment Sheet #1; Job Sheet #6)

(NOTE: Pneumatic rollers have two rows of rubber tires. The back tires cover the spaces between front tires. The roller is ballasted with gravel or other material for the proper compacting weight. Pneumatic rollers may be towed or self-propelled as in Figure 2.)

FIGURE 2



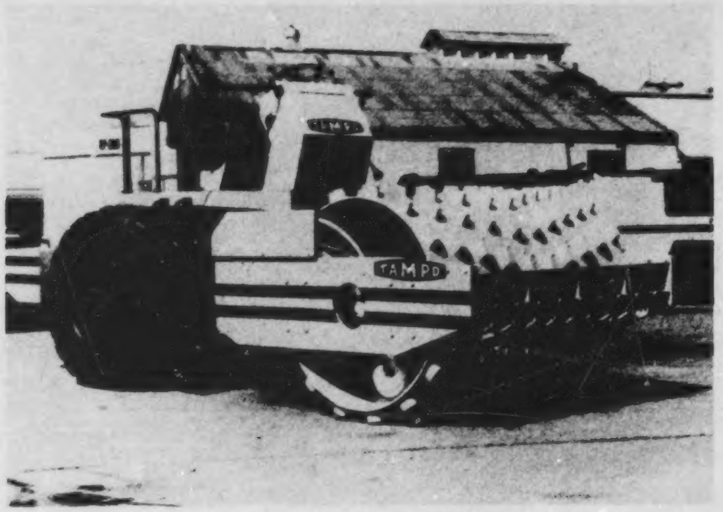
Courtesy of Ingram Mfg. Co.

INFORMATION SHEET

C. Padfoot roller (sheepsfoot) (Job Sheet #5)

(NOTE: The padfoot may be self-propelled or towed by a dozer or large tractor. It is very efficient in compacting around culverts, in back of bridge abutments, or any areas where several feet of fill is to be placed. This roller can be used on more uneven surfaces than the steel-wheel roller. It may be equipped with a vibrator.)

FIGURE 3

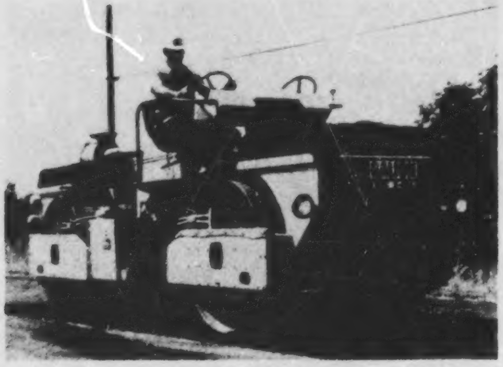


Courtesy of Tampo Rollers.

D. Vibratory roller (Job Sheet #8)

(NOTE: The vibratory roller is usually self-propelled, but may be towed. It is a steel-wheel roller with rotating weights inside the drum that create a vibration. It is used for greater compaction.)

FIGURE 4



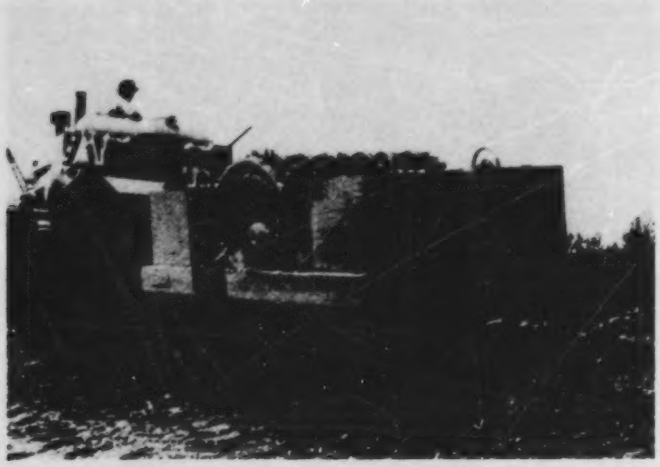
Courtesy of Galion Manufacturing Division, Dresser Industries, Inc. Galion, Ohio.

INFORMATION SHEET

E. Grid roller

(NOTE: Grid rollers are either self-propelled or towed and must be ballasted with large concrete blocks, sand, or aggregate.)

FIGURE 5



Courtesy of Hyster Company, Kewanee, Illinois.

III. Types of rollers and their highway maintenance operations (Job Sheets #5-#8)

A. Steel-wheel roller--Used to compact and smooth asphalt materials or aggregate, and to compact final grade material

(NOTE: The steel-wheel leaves a smooth surface but rides over the high spots. The pneumatic roller reaches all surface areas but leaves lines where the tire edges intersect. In the normal sequence of an asphalt operation, the steel-wheel compacts the asphalt, the pneumatic roller compacts and levels it, and then the steel-wheel follows, smoothing the wheel tracks and completing compaction.)

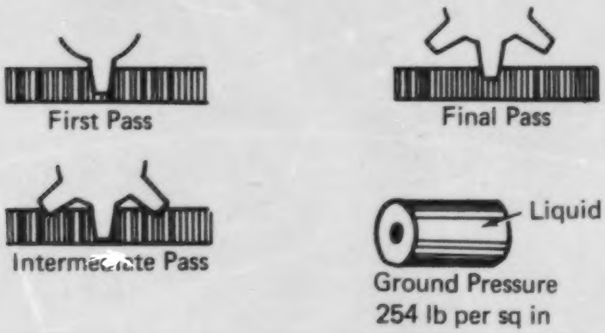
B. Pneumatic roller--Used to compact shallow lift fill, aggregate, and asphalt material

INFORMATION SHEET

C. Padfoot roller (sheepsfoot)--Used for concentrated, deep compaction on fill and aggregate

(NOTE: The padfoot roller compacts from the bottom to the top. On the first pass, the feet go into the material their full length. Each succeeding pass compacts the material until the roller feet work up to within 1 1/2 to 2 inches of the top, indicating that the material is solidly compacted. This is called "walking out." See Figure 6.)

FIGURE 6



First Pass

Final Pass

Intermediate Pass

Ground Pressure
254 lb per sq in

D. Vibratory roller--Used for compacting fill, asphalt material, and aggregate, especially in close, narrow places

EXAMPLES: Around culverts, overpasses, bridge abutments

E. Grid roller--Used to break up old asphalt road surfaces that have been ripped and to crush soft materials such as sandstone, soft limestone, and cinders

IV. Safety rules for operating rollers

A. Read operator's manual thoroughly: know your machine

B. Study departmental safety manual

C. Wear close-fitting clothing, hard hat, safety shoes, ear protection, and goggles as required

D. Know and observe hand signals

E. Be sure all safety guards and covers are secure and in place

F. Do not operate machine until you are sure personnel and obstructions are clear of area

G. Check all safety devices before moving machine

INFORMATION SHEET

H. Do not jump onto or from machine

I. Mount and dismount properly, using handholds and steps

J. Do not allow anyone to ride on machine

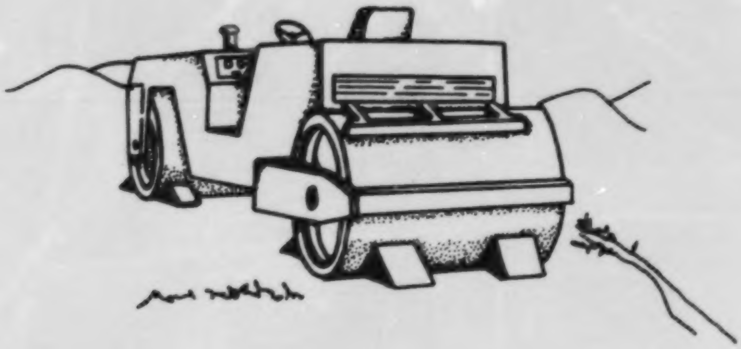
K. Know traffic pattern of job and obey spotter

L. Always park on level ground if possible

M. Block rollers front and back when needed (Figure 7)

(NOTE: *Always* block wheels on an incline.)

FIGURE 7



N. Do not leave engine running unattended

O. Avoid operating too close to banks or overhangs

P. Keep machine clean

Q. Watch for overhead obstructions

EXAMPLES: Low-hanging branches, building corners, signs

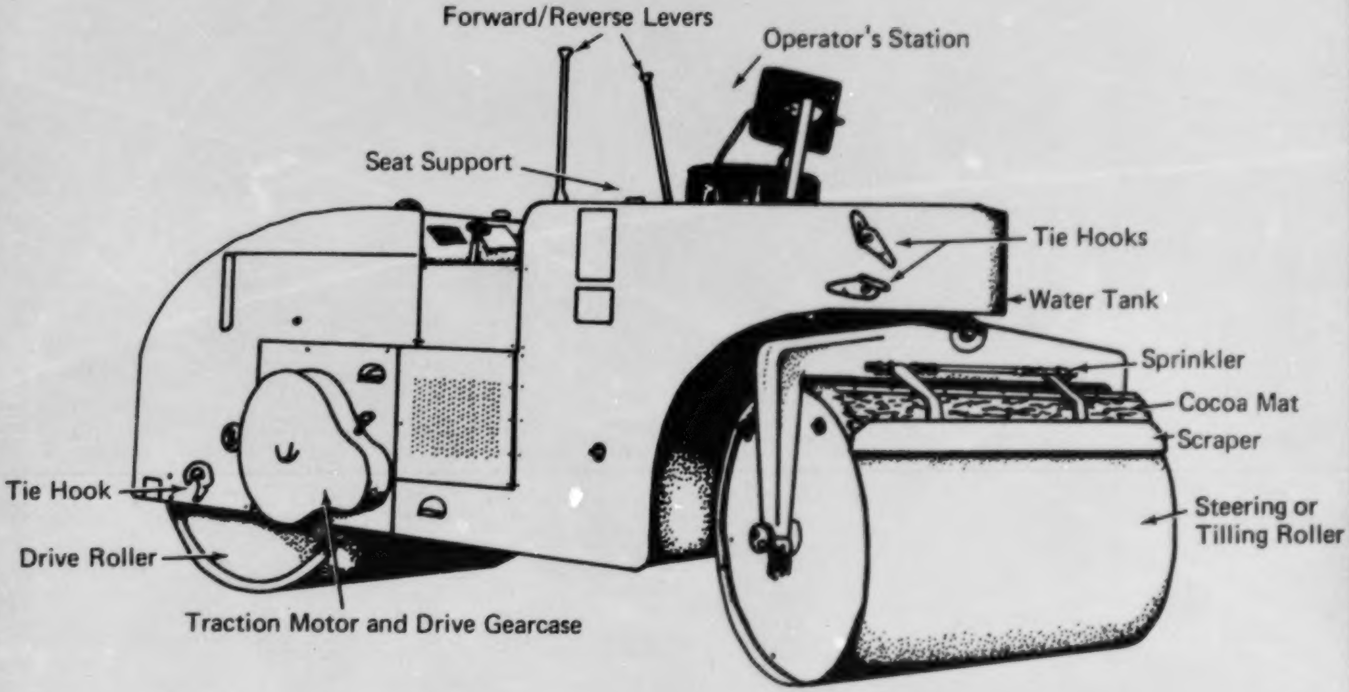
R. Do not exceed recommended speeds on level ground and inclines

INFORMATION SHEET

V. Parts of a roller (Figure 8)

(NOTE: Figure 8 illustrates a typical steel-wheel roller.)

FIGURE 8

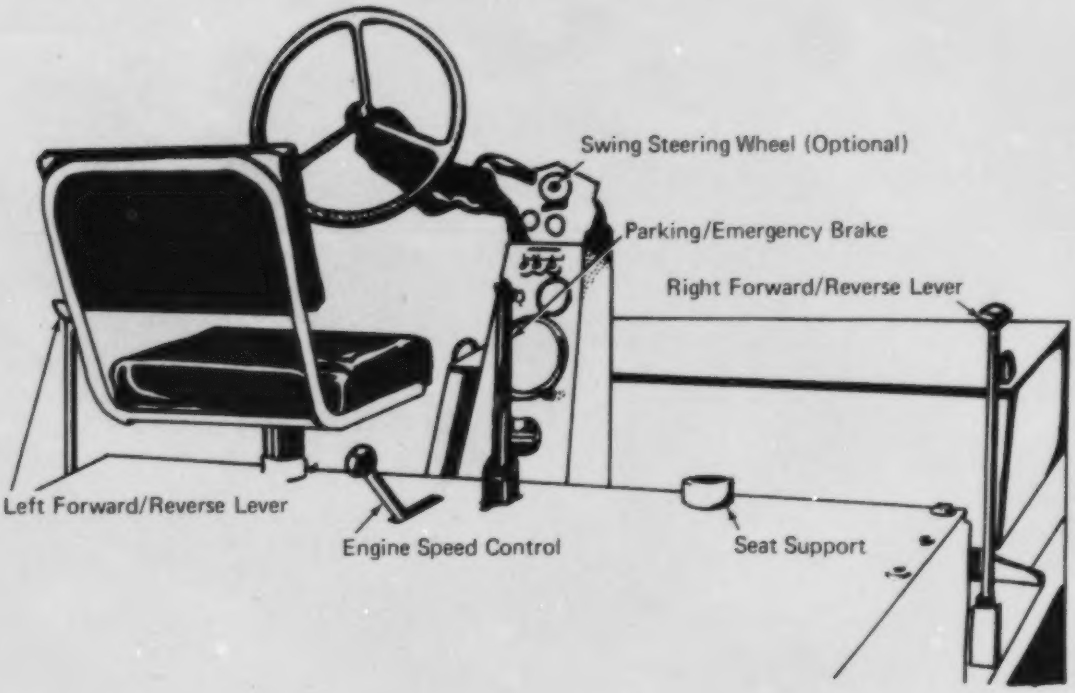

Forward/Reverse Levers
Operator's Station
Seat Support
Tie Hooks
Water Tank
Sprinkler
Cocoa Mat
Scraper
Steering or Tilling Roller
Tie Hook
Drive Roller
Traction Motor and Drive Gearcase

INFORMATION SHEET

VI. Controls on a typical roller (Figure 9; Job Sheet #4)

(NOTE: Controls vary with each manufacturer. However, the operation is essentially the same for all rollers. The example in Figure 9 is from a tandem steel-wheel roller. It is designed to be operated from either the left or right side. On this model, the seat and steering wheel will move to the right side. Many models have two operator seats and two steering mechanisms in addition to the two forward/reverse levers. Some are operated from one side only. A vibratory roller will have additional buttons or levers for activating the vibrator.)

FIGURE 9


Swing Steering Wheel (Optional)
Parking/Emergency Brake
Right Forward/Reverse Lever
Left Forward/Reverse Lever
Engine Speed Control
Seat Support

Used with permission of Galion Manufacturing Division, Dresser Industries, Inc., Galion, Ohio.

INFORMATION SHEET

VII. Maintenance procedures for rollers (Job Sheets #1-#3)

A. Follow departmental preventive maintenance program

B. Do not overtighten scraper blades

C. Drain water ballast from rollers and sprinkler tank if freeze is expected

D. Keep debris from accumulating under scraper blades

E. Place blocks in front of *and* behind both rollers when servicing roller

F. Fuel at end of day to prevent moisture condensation

G. Fill sprinkler tank daily with *clean* water

VIII. Procedures for effective roller operation (Transparency #1; Assignment Sheet #2)

(NOTE: These procedures apply mainly to steel-wheel rollers in asphalt operations but are generally true for all roller operations. The person in charge will tell you the amount and method of rolling necessary for the material used.)

A. Perform all prestart inspection and maintenance procedures

B. On hot or tacky materials, keep rollers wet during rolling operation to prevent asphalt from sticking to them

(NOTE: Sprinkler system must be in good operating condition and roller scrapers properly adjusted. Sprinklers should be turned on, scrapers adjusted, and the roller rotated several times *before* getting on new surface.)

C. On soft, pliable materials, run roller at slow speeds so that material will not be shoved or displaced

D. Keep speed constant; do not accelerate

E. Do not make sharp, fast turns

(NOTE: Steer the roller slowly so that material will not be marked or shoved out of place.)

F. Start, stop, and reverse roller slowly and smoothly

(NOTE: Moving too fast or jerkily will damage pavement.)

G. Do not leave roller standing on mat

(NOTE: Weight exerted by rollers will leave dips in the pavement.)

INFORMATION SHEET

H. Do not use roller to compact coarse or abrasive materials that will mar or damage the surface of the rollers

I. Design and follow a definite rolling pattern to assure uniform and correct compaction

J. Make breakdown pass with the drive roller

(NOTE: The drive roller must be in the lead on the breakdown pass.)

K. When rolling mat, start rolling at outside edges and roll inward toward center or crown

(NOTE: Always roll from the low side of the spread and progress toward the high side.)

L. Always make passes forward; return in reverse on same path to prevent scuffing

M. Overlap passes

(NOTE: Overlapping seals joints and increases density and bonding. Overlap may vary from 12 inches to one-half the width of the roller, depending on operation and type of roller. See operator's manual.)

N. Before reversing direction, steer to right (or left) to prevent material push-up

O. Use second and third passes to remove any end-of-roll marks

P. Seal edges of mat by rolling a 4-inch to 8-inch strip along joint

(NOTE: Rolling a strip along the joint levels the mat and waterproofs it. The width of the strip will be determined by the project supervisor.)

Q. Check surface after each pass and make corrections as needed

R. Park roller at an angle if you must park on mat

(NOTE: Any marks *across* the mat can be rolled out; marks left in the direction of the roll will be permanent.)

IX. Procedures for operating a vibratory roller (Job Sheet #8)

(NOTE: Weights mounted in the roller are rotated at high speed, causing the roller to vibrate and send shock waves through the material. These shock waves, and the static weight of the roller, cause the material to slide and rotate until it settles and bonds.)

A. Always operate vibrator in same direction as roller travel

INFORMATION SHEET

B. Do not stop roller while vibrating

(NOTE: When reversing roller travel, stop vibrator *before* roller comes to a stop. This will reduce the tendency of the roller to ridge the material at the end of a pass.)

C. If vibrating roll begins to bounce, stop vibrator

(NOTE: Bouncing indicates that maximum density has been reached.)

D. Use proper amplitude setting for depth of mat

(NOTE: Amplitude setting will vary with model and manufacturer. See operator's manual.)

E. Operate at proper frequency for amplitude setting

(NOTE: See operator's manual.)

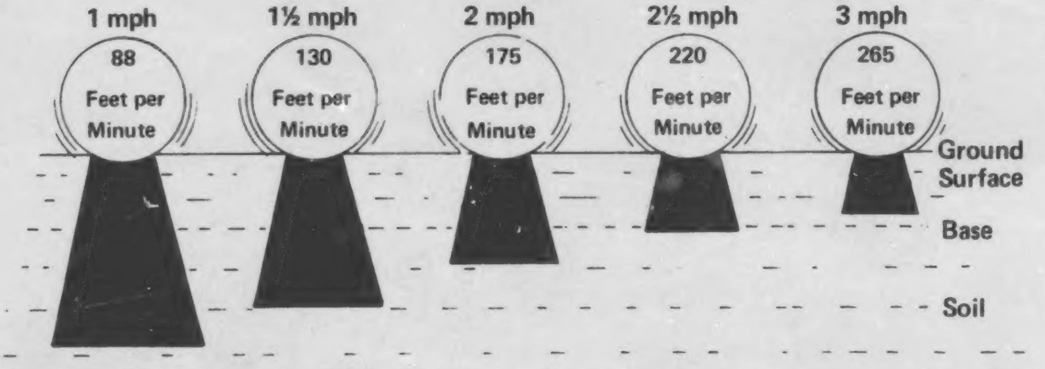
F. Use most effective roller travel speed for operation (Figure 10)

(NOTE: Slowing roller travel speed causes shock waves to penetrate more deeply and causes compaction at a greater depth. See operator's manual.)

EXAMPLE:

FIGURE 10

Travel Speed Versus Penetration at 1800 vpm


1 mph
88 Feet per Minute
1½ mph
130 Feet per Minute
2 mph
175 Feet per Minute
2½ mph
220 Feet per Minute
3 mph
265 Feet per Minute
Ground Surface
Base
Soil

Best compaction results will be experienced at low speeds. Recommended speed will vary from 1 mph (1.6 km) to 3 mph (4.8 km) depending on the nature of the material and depth of lift or material.

○ Vibrating Roll
■ Impact

Adapted with permission of Galion Manufacturing Division, Dresser Industries, Inc., Galion, Ohio.

INFORMATION SHEET

X. Procedures for operating on slope

   A. Avoid slopes or inclines when possible

   B. Operate up and down the slope, not across

   C. Select proper gear before starting on the slope

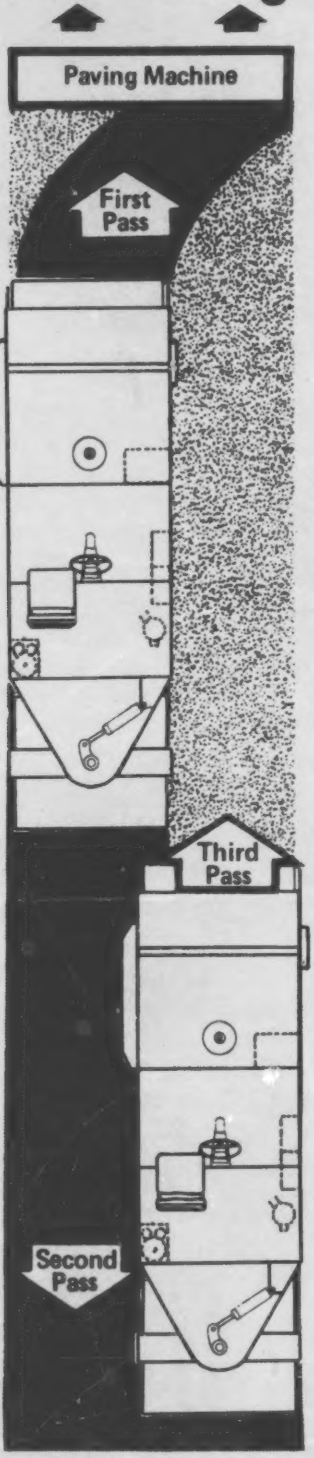
   D. Do not exceed 5 mph

   E. If your machine has a gearshift, select a low gear; if it has a hydrostatic drive, the speed control should be in the slow travel position

   F. Do not attempt to change gear selection while traveling on a grade

   G. If stopped on an incline, block both rolls front *and* rear

General Rolling Pattern


Paving Machine
First Pass
Third Pass
Second Pass

Prior to reversing direction of roll, steer to right (or left) to prevent material push-ups.

Make additional passes as required for density.

Maneuver on compacted area.

Overlap each pass.

Start in center of mat on deep-lift asphalt for initial pad.

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ROLLERS
UNIT III

ASSIGNMENT SHEET #1--DESCRIBE A PNEUMATIC ROLLER OPERATION

NAME ______________________________________ SCORE ____________

Many roller operators begin their careers on pneumatic rollers, so it is important that you have a good understanding of their operation.

Describe a pneumatic roller operation by answering the following questions.

A. What are pneumatic rollers used for in highway maintenance? ____________________

____

B. Compare uses and operations of steel-wheel and pneumatic rollers. Refer to Information Sheet, Section III.

____

____

____

____

____

____

C. Why do you check the ballast? ______________________________________

____

D. Can you pump water from a pond to fill the tanks? ______________ Why or why not? ____

(NOTE: For the following questions, assume that you are rolling a 2-inch asphalt mat, traveling behind the steel-wheel roller. Your travel speed should be 6 miles per hour.)

E. Will you use water on this operation? ___________ Why or why not? ___________

____

ASSIGNMENT SHEET #1

F. What gear range will you use according to the table below? ____________________

GEAR RANGE SPEEDS
(maximum speeds)

Low	3.5 mph
Second	7.5 mph
Third	14 mph
High	24 mph

G. Is the first pass in forward or reverse gear? ____________________

H. Do you start the first pass in the center or at the shoulder? ____________________

I. Do you turn the roller at the end of the first pass? ____________________

J. Does the second pass overlap the first pass? ____________________

K. If the steel-wheel roller speeds up, do you increase your speed also? ____________

Why or why not? ____________________

____

L. What is the procedure for starting and stopping? ____________________

____

____

M. What is the procedure for reversing direction? ____________________

____

____

ROLLERS
UNIT III

ASSIGNMENT SHEET #2--DESCRIBE A STEEL-WHEEL ASPHALT ROLLING OPERATION

NAME ______________________________ SCORE ____________________

Rolling of asphalt layers requires skill and care. A well-engineered and executed job, using the most advanced grading and leveling techniques and the best of materials and workmanship, can be ruined by slipshod rolling and finishing.

Using the information in this unit, particularly Information Sheet, Sections IV and VIII, and Transparency #1, describe the steps you would take to roll an asphalt surface course.

(NOTE: You will need to describe only the first two passes because all passes after that are the same.)

A. Safety procedures performed before rolling operation begins--____________________

____

____

____

____

____

____

B. First pass--____

____

____

____

____

____

____

ASSIGNMENT SHEET #2

C. Second and succeeding passes--

D. Procedures that will protect the surface--

ROLLERS
UNIT III

ANSWERS TO ASSIGNMENT SHEETS

Assignment Sheet #1

A. To compact shallow lift fill, aggregate, and asphalt material

B. The steel-wheel roller is used to compact and smooth asphalt materials or aggregate, and to compact final grade material; the pneumatic roller is used to compact shallow lift fill, aggregate, and asphalt material

(NOTE: The student may also include the following information. The steel-wheel leaves a smooth surface but rides over the high spots. The pneumatic roller reaches all surface areas but leaves lines where the tire edges intersect. In the normal sequence of an asphalt operation, the steel-wheel compacts the asphalt, the pneumatic roller compacts and levels it, and then the steel-wheel follows, smoothing the wheel tracks and completing compaction.)

C. To be sure that the weight is proper for compacting job

D. No. Water must be clean

E. Yes. To keep asphalt material from sticking to the rollers

F. Second

G. Forward

H. Shoulder

I. No

J. Yes

K. No; speed should be kept constant

L. Start and stop roller slowly and smoothly

M. Steer to right or left to prevent material push-up

(NOTE: Answer may include "reverse slowly and smoothly.")

Assignment Sheet #2

A. Description should include the following

1. Read operator's manual thoroughly: know your machine
2. Study departmental safety manual

ANSWERS TO ASSIGNMENT SHEETS

3. Wear close-fitting clothing, hard hat, safety shoes, ear protection, and goggles as required
4. Be sure all safety guards and covers are secure and in place
5. Check all safety devices
6. Be sure area is clear

B. Description should include the following

1. Start at shoulder or outside edge of mat
2. Roll forward with drive roller

   (NOTE: Roll with drive roller is sufficient, since some rollers have the drive roller at the rear.)
3. Travel at slow speeds
4. At end of pass, steer to right (or left) before reversing direction of roll
5. Stop roller slowly and smoothly
6. Check pass for places that need correction

C. Description should include the following

1. Return in reverse on same path as first pass
2. Reverse slowly and smoothly
3. Stop roller slowly and smoothly
4. Check pass for places that need correction
5. Start smoothly and slowly
6. Maneuver on compacted area
7. Roll with drive roller
8. Travel slowly
9. Overlap first pass
10. Steer to right (or left) before reversing direction
11. Use second and third passes to remove any end-of-roll marks
12. Check surface after each pass and make corrections as needed

ANSWERS TO ASSIGNMENT SHEETS

D. Description should include the following

1. Keep speed constant; do not accelerate
2. Do not make sharp, fast turns
3. Always make passes forward; return in reverse on same path to prevent scuffing
4. Do not leave roller standing on mat

ROLLERS
UNIT III

JOB SHEET #1--PERFORM PRESTART INSPECTION AND MAINTENANCE ON A STEEL-WHEEL ROLLER

I. Equipment and materials

A. Steel-wheel roller

B. Manufacturer's operating manual

C. Recommended crankcase lubricant, hydraulic fluid, and lubricating grease

D. Grease gun

E. Solvent

F. Shop rags

G. Steel or wire brush

II. Procedure

(NOTE: Deficiencies should be corrected immediately or reported to the proper authority. Do not operate defective equipment.)

A. Walk around steel-wheel roller, making a visual inspection for leaks and broken, worn, or missing parts

B. Clean all grease, oil, mud, and dirt from steps, floor, handholds and controls

C. Remove any mud or foreign objects from scrapers and around brake and power-steering hoses and linkages

D. Check for loose bolts and nuts

E. Check hydraulic fluid level; add fluid if needed

F. Check brake fluid level; add fluid if needed

G. Check engine oil level; add or change oil if needed

H. Check engine coolant level; add coolant if needed

I. Lubricate all pressure fittings according to manufacturer's instructions

J. Check fuel level; fill tank if needed

(CAUTION: Do not smoke while checking and filling fuel tank.)

JOB SHEET #1

K. Check all hydraulic hoses and fittings for leaks

L. Check fuel system for leaks

M. Check cooling system for leaks

N. Check hydraulic cylinders for loose pins or loose clevis

O. Check all control cables, control rods, and control arms for loose connections or wear

P. Remove any tools or other items that could interfere with operation of roller or controls

Q. Check for proper tension on all V-belt drives

R. Check radiator and oil cooler for leaks or dirt-clogged fins; clean fins if needed

S. Check fuel supply filters and water trap

(NOTE: Drain water trap until only clean fuel appears.)

T. Check dry air cleaner filter; clean or replace if condition indicator shows red

(NOTE: Replace air cleaner filter daily if working in extremely dusty conditions.)

U. Check hydrostatic filter; replace if necessary

ROLLERS
UNIT III

JOB SHEET #2--PERFORM PRESTART INSPECTION AND MAINTENANCE ON A PNEUMATIC ROLLER

I. Equipment and materials

- A. Pneumatic roller
- B. Manufacturer's operating manual
- C. Recommended crankcase lubricant, hydraulic fluid, and lubricating grease
- D. Grease gun
- E. Shop rags

II. Procedure

(NOTE: Deficiencies should be corrected immediately or reported to the proper authority. Do not operate defective equipment.)

- A. Walk around pneumatic roller, making a visual inspection for leaks and broken, worn, or missing parts
- B. Check V-belt for tension and wear; adjust or replace if necessary
- C. Check battery water and connections; add water if needed
- D. Check air cleaner; clean as needed

  (NOTE: Clean daily under severe conditions.)
- E. Check fuel filter or water trap; clean or replace if needed
- F. Check fuel supply; fill tank if necessary
- G. Check radiator water level; clean fins if clogged, and add water if needed
- H. Check crankcase oil level; add oil if needed
- I. Check hydraulic lines and fittings for leaks; tighten if necessary
- J. Check hydraulic reservoir levels; add fluid if needed
- K. Check hydraulic cylinder for loose pins; adjust as necessary
- L. Check hydraulic control linkages; adjust if necessary
- M. Check rollers for loose bolts; tighten bolts if necessary
- N. Check roller control linkages for wear

JOB SHEET #2

O. Check all gear cases; grease if necessary

(NOTE: See manufacturer's lubrication chart for location and type of lubricant.)

P. Grease drive axle bearings according to operator's manual

Q. Grease all pressure fittings as shown on manufacturer's lubrication chart

R. Lubricate final drive chain

S. Check brakes; remove foreign matter from around brake hoses and brake linkages

T. Inspect all brake lines and connections for leaks; repair or replace if necessary

U. Check fluid level in master brake cylinder; add fluid if needed

V. On hydrostatic drive models

1. Check oil level; add oil if needed
2. Replace filter if indicated on vacuum gauge

(NOTE: Engine must be running to check vacuum gauge.)

ROLLERS
UNIT III

JOB SHEET #3--SERVICE A VIBRATORY ROLLER

I. Equipment and materials

  A. Vibratory roller

  B. Operator's manual

  C. Tool kit

  D. Air supply

  E. Grease gun

  F. Lubricants

  G. Cleaning solvents

  H. Rags

  I. Water

  J. Engine coolant

  K. Engine oil

  L. Hydraulic fluid

  M. Transmission fluid

  N. Brake fluid

  O. Tire pressure gauge

  P. Fuel

II. Procedure

(NOTE: Follow departmental preventive maintenance program when servicing equipment. Refer to operator's manual for lubrication chart and for servicing specific components and attachments.)

  A. Visually inspect for leaks and broken, worn, or missing parts

  (NOTE: Major repairs and replacements should be reported to the proper authority and completed by a trained mechanic.)

  B. Check engine oil level, filter, lines, and hoses; add engine oil if needed

JOB SHEET #3

C. Check engine coolant level, radiator cap, hose, and radiator; add coolant if needed

(CAUTION: Do not remove radiator cap unless engine is cool; then, open cap slowly to release pressure.)

D. Clean air filter; replace if necessary

E. Check fuel level, fuel filters, and sediment bowl (where applicable); fill fuel tank if necessary

F. Check battery electrolyte level, battery cables, and connectors; add water or electrolyte if needed

(CAUTION: Keep sparks and fire away from battery.)

G. Check exhaust system for loose connections and holes

H. Check hydraulic fluid level, filters, hoses, lines, and fittings; look for leaks; add fluid if needed

I. Check hydraulic cylinders for loose pins or loose clevis

J. Check transmission fluid level; add fluid if needed

K. Check transmission pressure in filter and breather

L. Check differential oil level; add oil if needed

M. Check brake adjustment and condition; adjust if necessary

N. Check brake master cylinder fluid level; add fluid if needed

O. Check clutch adjustment; adjust if necessary

P. Check drive belts for tension and wear; adjust or replace if necessary

Q. Check wiring, insulation, and connections

R. Clean and lubricate all grease fittings according to operator's manual

S. Check condition of tires

T. Check tire pressure; inflate to recommended pressure if necessary

U. Check all safety devices; repair if necessary

V. Check major components and/or accessories

  1. Vibrator-housing oil level; add oil if needed
  2. Steering cylinder clevis, cap screw/locknut

ROLLERS
UNIT III

JOB SHEET #4--START, WARM UP, OPERATE, AND SHUT DOWN A ROLLER

I. Equipment

- A. Self-propelled roller
- B. Operator's manual
- C. Recommended safety equipment
  - 1. Hard hat
  - 2. Safety shoes
  - 3. Hearing protection
- D. Roller blocks

II. Procedure for starting and warm-up

(NOTE: Read operator's manual thoroughly and carefully. Check manual for specific procedures.)

- A. Complete all prestart checks and service according to manual
- B. Mount roller, using grips and steps
- C. If roller is equipped with a roll-over protective structure (ROPS), fasten seat belt
- D. Set parking brake
- E. Place forward/reverse lever at NEUTRAL or STOP
- F. Place throttle at IDLE
- G. Turn ignition key switch to ON
- H. Push starter button

  (NOTE: Do not crank engine longer than twenty seconds. Wait at least thirty seconds before cranking engine again.)
- I. Allow engine to warm up according to manufacturer's instructions
- J. Check voltmeter, engine oil-pressure gauge, water temperature gauge, and hydrostatic oil-temperature gauge for proper readings according to manufacturer's specifications
- K. Listen for unusual noises

JOB SHEET #4

L. Increase engine speed gradually to manufacturer's recommended revolutions per minute

M. Check gauges again

(NOTE: Voltmeter should show slightly higher charge rate, and engine oil pressure will rise slightly. If pressure is below recommended level, shut down and troubleshoot.)

III. Procedures for operating

(NOTE: Check operator's manual for specific procedures.)

A. Check to see that area is clear of personnel and obstacles

B. Select proper gear according to operator's manual

C. Increase throttle setting to manufacturer's recommended rpm

D. If vibrator is to be used, engage vibrator control according to operator's manual

E. Release parking brake

F. Adjust forward/reverse lever for proper speed and direction

G. Readjust throttle if necessary

H. Compact material

I. Check gauges periodically during operation

J. To change gear range, change direction or change vibration amplitude, bring roller to a complete stop before making change

IV. Procedure for shutting down engine

(NOTE: Check operator's manual for specific procedures.)

A. If vibrator is used, place vibrator control lever in NEUTRAL

(NOTE: Some models automatically shut off vibrators when forward/reverse levers are brought to NEUTRAL.)

B. Slowly move forward/reverse control lever to NEUTRAL

(NOTE: Do not use emergency brake to stop roller except when absolutely necessary.)

C. Set parking brake

D. Allow engine to idle three to five minutes to cool down

JOB SHEET #4

E. Turn ignition key switch to OFF

(NOTE: On diesel engine models, shut down engine according to operator's manual.)

F. Remove key

G. Dismount, using handholds and steps

H. Block front and back of both rollers

ROLLERS
UNIT III

JOB SHEET #5--COMPACT SUBGRADE WITH A PADFOOT ROLLER

I. Equipment and materials

   A. Padfoot roller, self-propelled or towed

   B. Operator's manual

   C. Transport vehicle--Large flatbed; large, towed trailer; or low-boy

   D. Recommended safety equipment

      1. Close-fitting clothing

      2. Hard hat

      3. Safety shoes

      4. Hearing protection

      5. Eye protection

II. Procedure

   A. Make a visual inspection of roller for any deficiencies; repair or correct as necessary

   B. Complete required servicing

   C. Check operator's manual to determine if roller requires ballast

   D. Check ballast and increase or decrease to get desired roller weight for operation

   E. Start roller

   F. Load roller on hauling vehicle, following manufacturer's loading and lashing procedures

   (NOTE: Most types of rollers can be moved short distances from job to job; but because of the feet, the padfoot should always be hauled on a transport vehicle.)

   G. Shut down roller

   H. Transport roller to job site

   I. Start roller

JOB SHEET #5

J. Unload roller following unloading procedure

K. Position roller at starting point

L. Set parking brake

M. Make a visual check of the work area to see that it is clear of personnel and unnecessary equipment

N. Place transmission gear-range lever in desired gear range

(NOTE: Select gear range that will allow engine to run at maximum speed during operation. This will avoid overheating the transmission.)

O. Release parking brake

P. Place forward/reverse lever in position

Q. Move forward along one side of roadway, overlapping edge 6 to 8 inches

R. At end of section being worked, turn around and position roller so that it overlaps the former pass 12 to 24 inches; return to starting point

S. Continue this procedure until desired density is achieved across width of roadway

T. When job is completed, load roller on transport, following loading procedures

U. Set parking brake

V. Shut down engine

W. Secure roller, following correct lashing procedures

ROLLERS
UNIT III

JOB SHEET #6--COMPACT ASPHALT MAT WITH A PNEUMATIC ROLLER

I. Equipment and materials

- A. Pneumatic roller
- B. Operator's manual
- C. Aggregate for ballast if needed
- D. Roller blocks
- E. Recommended safety equipment
    1. Close-fitting clothing
    2. Hard hat
    3. Safety shoes
    4. Hearing protection
    5. Eye protection

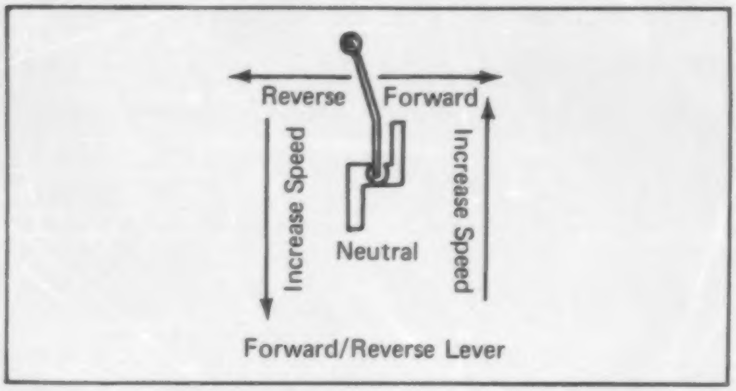
II. Procedure

- A. Make a visual check of roller for any apparent deficiencies; repair or correct as necessary
- B. Perform prestart inspection and maintenance
- C. Check ballast; increase or decrease ballast to obtain desired roller weight
- D. Start engine
- E. Position roller at starting point
- F. Set parking brake

JOB SHEET #6

G. Set forward/reverse shuttle lever in neutral position (Figure 11)

FIGURE 11


Reverse
Forward
Increase Speed
Increase Speed
Neutral
Forward/Reverse Lever

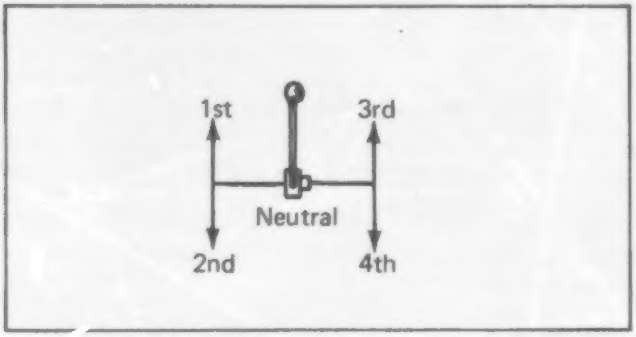
Used with permission of Bros. Inc.

H. Make certain that area is clear of personnel and obstacles

I. Place transmission shift lever in desired gear range (Figure 12)

(NOTE: See operator's manual.)

FIGURE 12


1st
3rd
Neutral
2nd
4th

Used with permission of Bros. Inc.

J. Release parking brake

K. Move forward/reverse lever to forward travel position

L. Move forward along one side of road with roller overlapping the edge 5 to 6 inches

JOB SHEET #6

M. At end of section being compacted, reverse direction and position roller so that it overlaps first pass about one-half the width of the roller

(NOTE: On blade-laid operations, stay off the windrow.)

N. Continue in reverse until starting point is reached

O. Continue this procedure until desired density is achieved for full width of roadway

P. Park roller on as level ground as is possible

Q. Place gearshift range lever and forward/reverse lever in neutral

R. Set parking brake

S. Shut down engine

T. Dismount and block both front and back wheels on both sides

ROLLERS
UNIT III

JOB SHEET #7--COMPACT ASPHALT MAT WITH A STEEL-WHEEL ROLLER

I. Equipment and materials

- A. Steel-wheel roller
- B. Water tank
- C. Operator's manual
- D. Roller blocks
- E. Recommended safety equipment
  1. Close-fitting clothing
  2. Hard hat
  3. Safety shoes
  4. Hearing protection
  5. Eye protection

II. Procedure

- A. Perform required service
- B. Check steering and driving mechanism

  (NOTE: They must be in good working order.)
- C. Check roller drums for flat spots and ridges
- D. Transport roller to job site
- E. Check ballast; increase or decrease water to obtain desired roller weight
- F. Fill sprinkler tank
- G. Check spray bars and mats for wear and proper operation
- H. Start engine
- I. Position roller at starting point on edge of roadway

JOB SHEET #7

J. When mix has cooled to correct temperature, as determined by project supervisor, place transmission shift lever in desired gear range

(NOTE: See operator's manual.)

K. Place forward/reverse lever in forward position

L. Start smoothly and slowly, rolling edge of mat

M. Roll forward until the designated point is reached

(CAUTION: Never roll hot asphalt at speeds over 3.5 mph. Do not make sudden starts, stops, or turns, and do not let roller stand on uncured pavement.)

N. Steering to the right (or left) to prevent material push-up, slowly bring roller to a stop

O. Check area for corrections

P. Place forward/reverse lever in reverse and roll back to the starting point on same path

Q. Line up roller for next pass to overlap previous pass 12 to 18 inches

R. Continue with forward and backward rolling until full width of newly spread material meets required density and is free of wheel tracks

(CAUTION: Do not leave roller parked on fresh pavement.)

S. When compaction is completed, move roller onto compacted cold surface

T. Place transmission shift lever and forward/reverse lever in neutral position

U. Set emergency brake

V. Shut down engine

W. Dismount and place blocks in front and back of both rollers

ROLLERS
UNIT III

JOB SHEET #8--COMPACT ASPHALT MAT WITH A VIBRATORY ROLLER

I. Equipment and materials

- A. Vibratory roller (steel wheel)
- B. Water tank
- C. Operator's manual
- D. Roller blocks
- E. Recommended safety equipment
  1. Hard hat
  2. Gloves
  3. Goggles
  4. Respirator
  5. Fire extinguisher

II. Procedure

- A. Perform all prestart inspection and maintenance procedures
- B. Transport roller to job site
- C. Fill sprinkler tank with clean water
- D. Check spray bars and mats for wear and proper operation
- E. Start engine
- F. Position roller at starting point on edge of roadway
- G. Determine and set amplitude and frequency if roller is so equipped
- H. When mix has cooled to correct temperature, place transmission shift lever in desired gear range
- I. Place forward/reverse lever in forward position
- J. Activate sprinklers and vibrators as roller moves forward smoothly and slowly with a 4-inch to 6-inch drum overhang

JOB SHEET #8

K. Roll forward to designated point

L. Steer to the right (or left) to prevent material push-up

M. Turn off vibrators and sprinklers and bring roller to a smooth stop

(NOTE: On some models, the vibrators shut off automatically as the roller comes to a stop.)

(CAUTION: Make sure vibrators are turned off before roller comes to a complete stop.)

N. Check area for corrections

O. Place forward/reverse lever in reverse

P. Reverse direction of vibration if needed

(NOTE: Be sure vibrators are impacting in the same direction as roller travel. Check operator's manual. Some rollers reverse automatically when transmission is in reverse gear.)

Q. Activate sprinklers and vibrators as roller starts backward on same path made on first pass

(NOTE: Be sure beginning movement is slow and smooth.)

R. Return to starting point

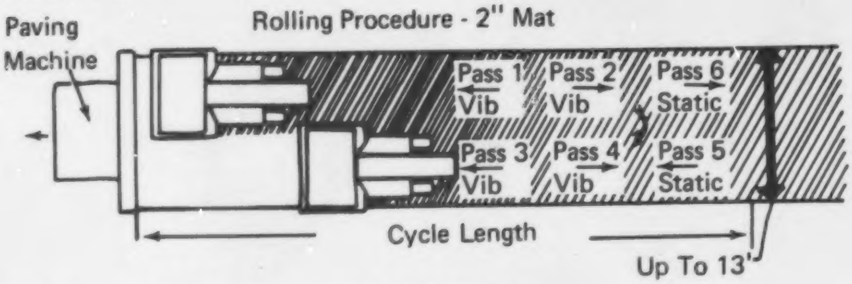
S. Turn off vibrators and sprinklers as roller comes to a smooth stop

(NOTE: Turn off vibrator *before* roller stops.)

T. Line up roller to overlap previous pass by 4 to 6 inches

U. Repeat procedure according to the following diagram (Figure 13)

FIGURE 13


Rolling Procedure - 2" Mat
Paving Machine
Pass 1 ← Vib
Pass 2 → Vib
Pass 6 → Static
Pass 3 ← Vib
Pass 4 → Vib
Pass 5 ← Static
Cycle Length
Up To 13'

Used with permission of RayGo, Inc., Minneapolis, Minnesota.

JOB SHEET #8

V. Continue until surface meets the required density and is free of drum tracks

(CAUTION: Do not leave roller parked on fresh pavement.)

W. Move roller onto compacted cold surface

X. Place transmission shift lever and forward/reverse lever in neutral position

Y. Set emergency brake

Z. Perform shutdown procedure

AA. Dismount properly

BB. Place blocks in front and back of both rollers

ROLLERS
UNIT III

TEST

NAME ________________________ SCORE ______________

1. Match terms associated with rollers to their correct definitions. Write the correct numbers in the blanks.

_____a. Fabric of wood fibers that distributes water as a film of moisture over the entire roller surface as it turns against it

_____b. Initial compaction

_____c. Asphalt material mixed and placed by a motor grader

_____d. Sticky

_____e. Soil used for bulk

_____f. System that moistens roller to keep hot asphalt from sticking to roller

_____g. Liquid asphalt material mixed with fine or coarse aggregate

_____h. Newly laid asphalt surface; may be hot or cold asphalt mix, several inches thick

_____i. Thickness of material spread in one layer

_____j. Truck-mounted or portable weighted cylinder(s) used to compact aggregate into liquid asphalt and to compact grades, fills, and asphalt mats

_____k. Height a vibrating roller travels or bounces

_____l. Crushed rock or gravel screened to sizes for use in road surfaces, concrete, or asphalt mixes

_____m. Heavy material, such as water, sand, or concrete, that has no function in a machine except to increase weight

_____n. Pressing material together to increase density

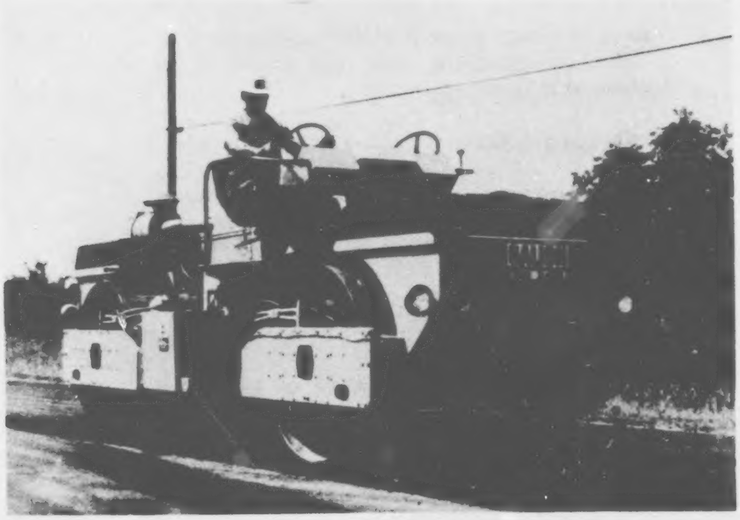
_____o. Blades that clean the rollers

1. Mix
2. Compaction
3. Sprinkler system
4. Lift
5. Amplitude
6. Mat
7. Blade-laid operation
8. Fill
9. Cocoa mat
10. Breakdown rolling
11. Aggregate (chips)
12. Ballast
13. Scrapers
14. Tacky
15. Roller

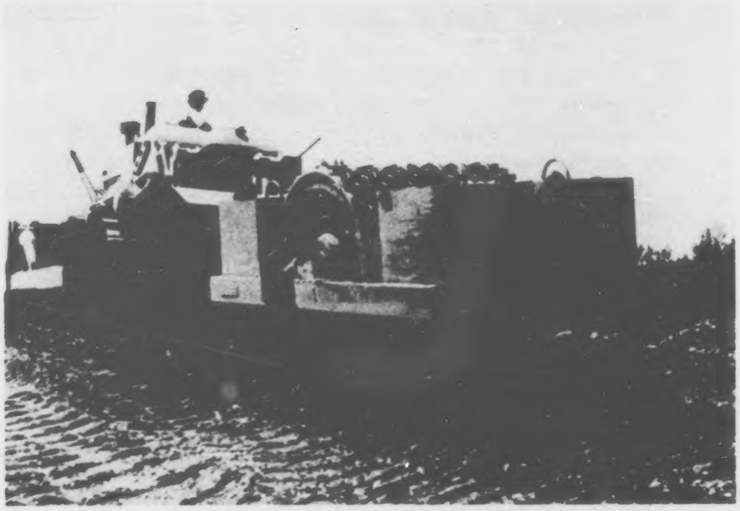
TEST

2. Identify types of rollers used in highway maintenance operations. Write the correct names in the blanks.

Padfoot roller (sheepsfoot)
Pneumatic roller
Steel-wheel roller (tandem roller)
Grid roller
Vibratory roller

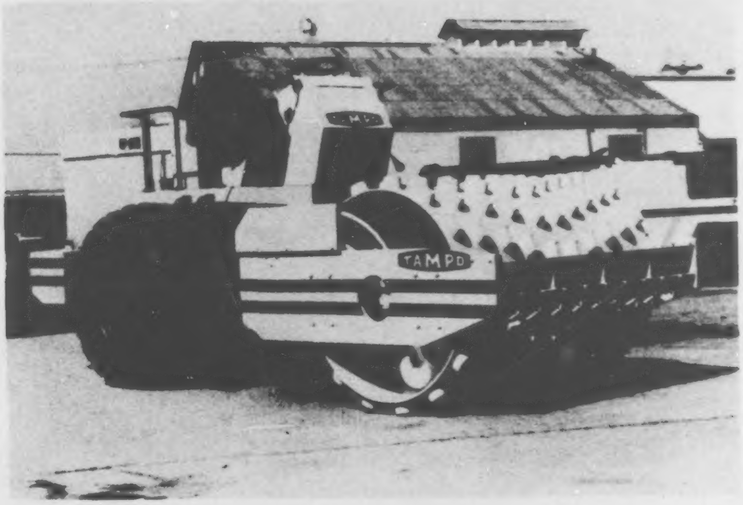


a. ________________________________

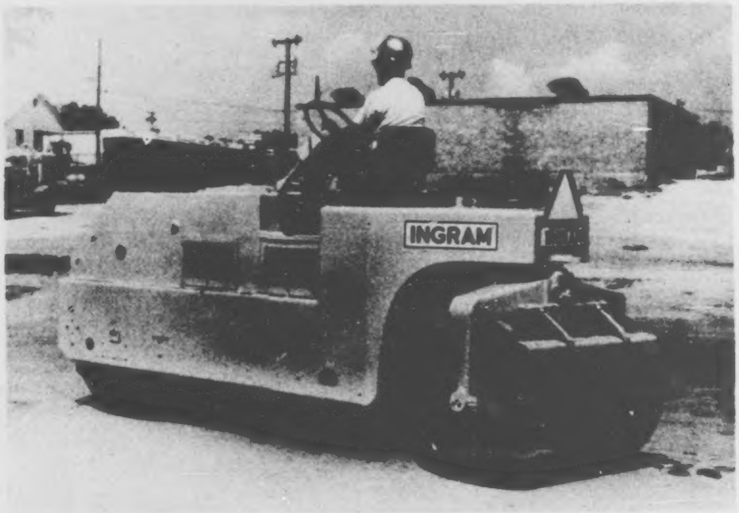


b. ________________________________

TEST

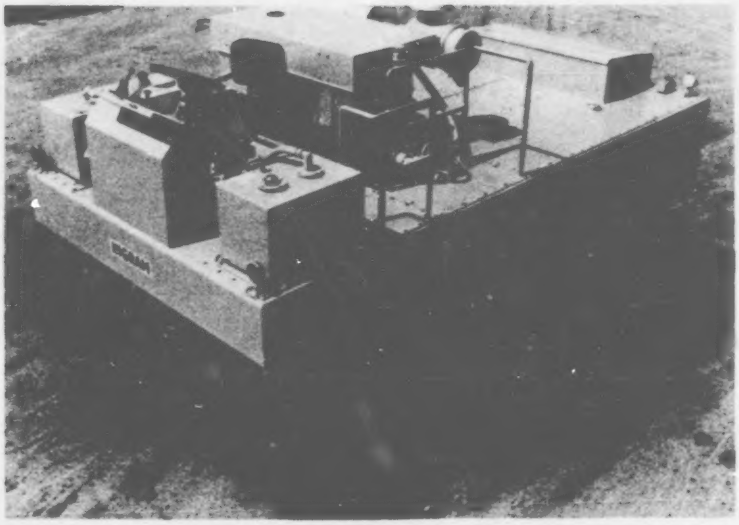


c. ____________________



d. ____________________

TEST



e.____

3. Match types of rollers to their correct highway maintenance operations. Write the correct numbers in the blanks.

_____a. Used for compacting fill, asphalt material, and aggregate, especially in close, narrow places

_____b. Used to compact shallow lift fill, aggregate, and asphalt material

_____c. Used for concentrated, deep compaction on fill and aggregate

_____d. Used to compact and smooth asphalt materials or aggregate, and to compact final grade material

_____e. Used to break up old asphalt road surfaces that have been ripped and to crush soft materials such as sandstone, soft limestone, and cinders

1. Padfoot roller (sheepsfoot)
2. Steel-wheel roller
3. Vibratory roller
4. Grid roller
5. Pneumatic roller

TEST

4. State ten safety rules for operating rollers.

a. ______________________________

b. ______________________________

c. ______________________________

d. ______________________________

e. ______________________________

f. ______________________________

g. ______________________________

h. ______________________________

i. ______________________________

j. ______________________________

TEST

5. Identify parts of a roller. Write the correct numbers in the blanks.

______a. Steering or tilling roller

______b. Traction motor and drive gearcase

______c. Forward/reverse levers

______d. Water tank

______e. Cocoa mat

______f. Operator's station

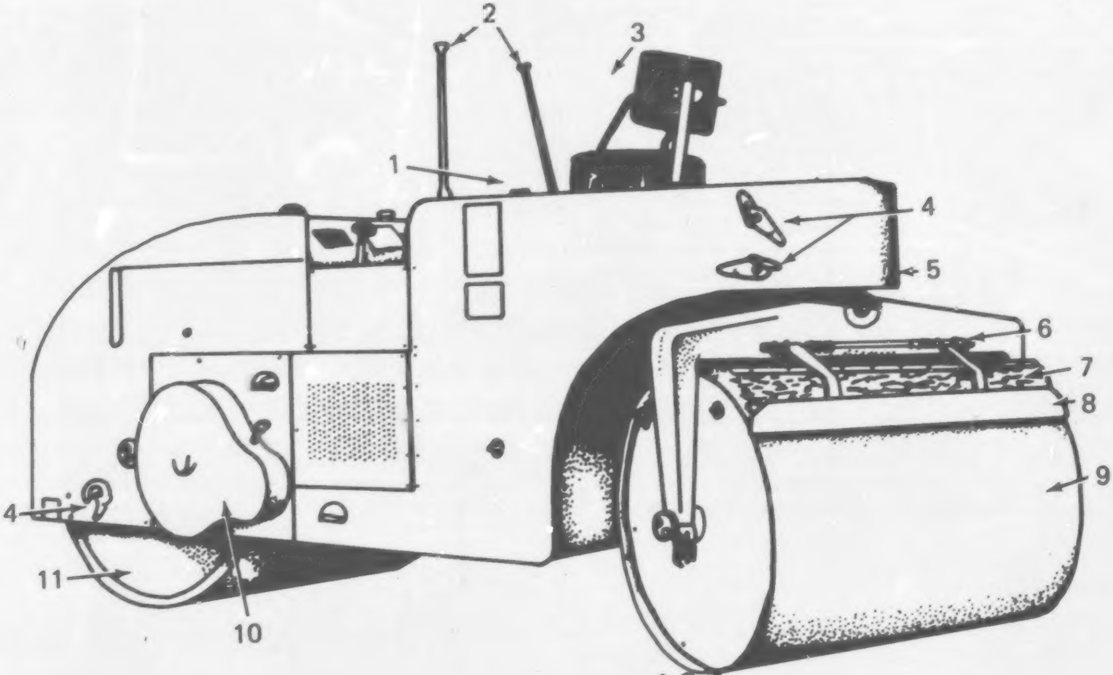
______g. Seat support

______h. Tie hooks

______i. Drive roller

______j. Scraper

______k. Sprinkler



TEST

6. Identify controls on a typical roller. Write the correct numbers in the blanks.

_____a. Parking/emergency brake

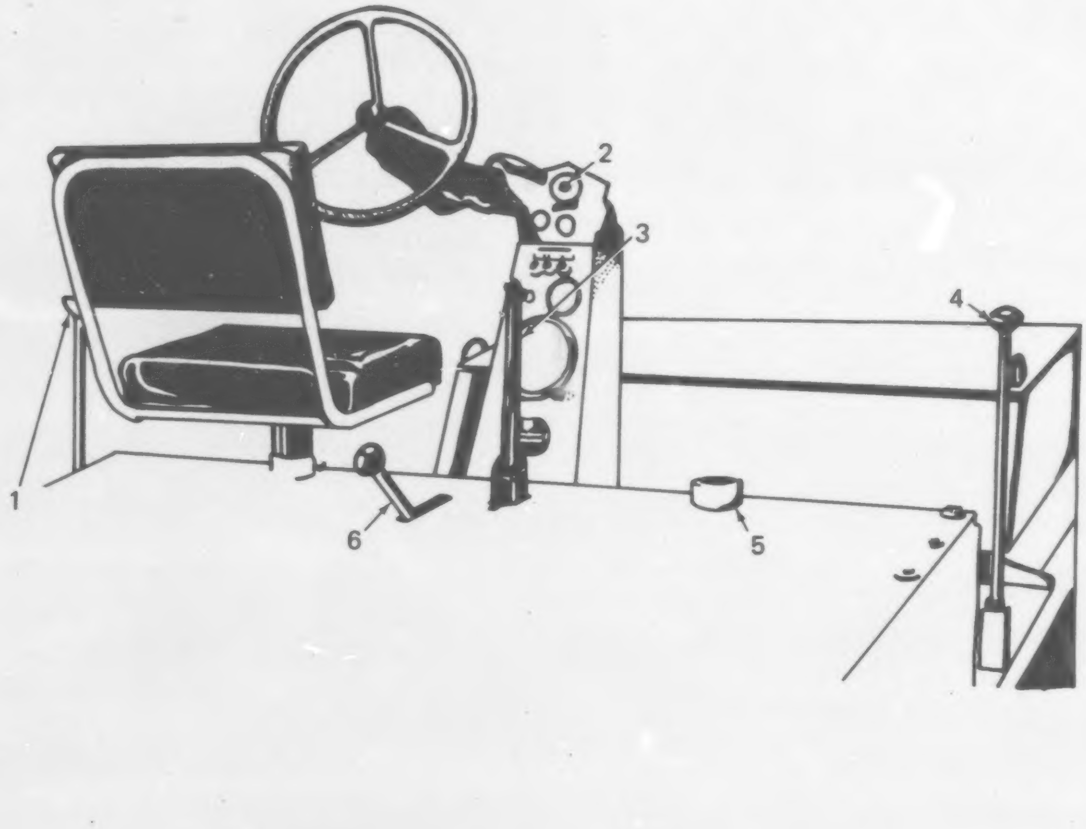
_____b. Seat support

_____c. Left forward/reverse lever

_____d. Swing steering wheel (optional)

_____e. Engine speed control

_____f. Right forward/reverse lever



TEST

7. Select from the following list maintenance procedures for rollers. Write an "X" in the blank before each correct answer.

______a. Drain water ballast from rollers and sprinkler tank if freeze is expected

______b. Fuel at end of day to prevent moisture condensation

______c. Remove cocoa mat to dry after each use

______d. Drain fuel tank at end of day to prevent moisture condensation

______e. Do not overtighten scraper blades

______f. Replace driver's seat to original position after each operation

______g. Keep debris from accumulating under scraper blades

______h. Place blocks in front of *and* behind both rollers when servicing roller

______i. Fill sprinkler tank daily with *clean* water

______j. Do not fill ballast tank more than two-thirds full

______k. Drain water ballast from rollers and sprinkler tank daily

______l. Perform all manufacturer's inspection and service procedures weekly

8. State ten procedures for effective roller operation.

a. ____

b. ____

c. ____

d. ____

e. ____

f. ____

g. ____

h. ____

i. ____

j. ____

TEST

9. Select from the following list procedures for operating a vibratory roller. Write an "X" in the blank before each correct answer.

______a. Travel at highest speed possible for the operation

______b. Do not stop roller while vibrating

______c. If vibrating roll begins to bounce, move roller off mat

______d. Use most effective roller travel speed for operation

______e. Always operate vibrator in same direction as roller travel

______f. Keep vibrator in operation when reversing directions

______g. Use proper amplitude setting for depth of mat

______h. Operate at proper frequency for depth of mat

______i. Use proper amplitude setting for frequency setting

______j. Operate at proper frequency for amplitude setting

10. State five procedures for operating on slopes.

a. ____

b. ____

c. ____

d. ____

e. ____

(NOTE: Test questions 11-13 list the assignment and job sheets. They are an important part of this test. If they have not been completed, check with your instructor.)

11. Describe a pneumatic roller operation.

12. Describe a steel-wheel asphalt rolling opeation.

13. Demonstrate the ability to

    a. Perform prestart inspection and maintenance on a steel-wheel roller.

    b. Perform prestart inspection and maintenance on a pneumatic roller.

    c. Service a vibratory roller.

    d. Start, warm up, operate, and shut down a roller.

    e. Compact subgrade with a padfoot roller.

TEST

f. Compact asphalt mat with a pneumatic roller.

g. Compact asphalt mat with a steel-wheel roller.

h. Compact asphalt mat with a vibratory roller.

ROLLERS
UNIT III

ANSWERS TO TEST

1. a. 9
   b. 10
   c. 7
   d. 14
   e. 8
   f. 3
   g. 1
   h. 6
   i. 4
   j. 15
   k. 5
   l. 11
   m. 12
   n. 2
   o. 13

2. a. Vibratory roller
   b. Grid roller
   c. Padfoot roller (sheepsfoot)
   d. Steel-wheel roller (tandem roller)
   e. Pneumatic roller

3. a. 3
   b. 5
   c. 1
   d. 2
   e. 4

4. Answer should include any ten of the following
   a. Read operator's manual thoroughly: know your machine
   b. Study departmental safety manual
   c. Wear close-fitting clothing, hard hat, safety shoes, ear protection, and goggles as required

ANSWERS TO TEST

d. Know and observe hand signals

e. Be sure all safety guards and covers are secure and in place

f. Do not operate machine until you are sure personnel and obstructions are clear of area

g. Check all safety devices before moving machine

h. Do not jump onto or from machine

i. Mount and dismount properly, using handholds and steps

j. Do not allow anyone to ride on machine

k. Know traffic pattern of job and obey spotter

l. Always park on level ground if possible

m. Block rollers front and back when needed

n. Do not leave engine running unattended

o. Avoid operating too close to banks or overhangs

p. Keep machine clean

q. Watch for overhead obstructions

r. Do not exceed recommended speeds on level ground and inclines

5. a. 9
   b. 10
   c. 2
   d. 5
   e. 7
   f. 3
   g. 1
   h. 4
   i. 11
   j. 8
   k. 6

6. a. 3
   b. 5
   c. 1
   d. 2
   e. 6
   f. 4

ANSWERS TO TEST

7. a, b, e, g, h, i

8. Answer should include any ten of the following

   a. Perform all prestart inspection and maintenance procedures

   b. On hot or tacky materials, keep rollers wet during rolling operation to prevent asphalt from sticking to them

   c. On soft, pliable materials, run roller at slow speeds so that material will not be shoved or displaced

   d. Keep speed constant; do not accelerate

   e. Do not make sharp, fast turns

   f. Start, stop, and reverse roller slowly and smoothly

   g. Do not leave roller standing on mat

   h. Do not use roller to compact coarse or abrasive materials that will mar or damage the surface of the rollers

   i. Design and follow a definite rolling pattern to assure uniform and correct compaction

   j. Make breakdown pass with the drive roller

   k. When rolling mat, start rolling at outside edges and roll inward toward center or crown

   l. Always make passes forward; return in reverse on the same path to prevent scuffing

   m. Overlap passes

   n. Before reversing direction, steer to right (or left) to prevent material push-up

   o. Use second and third passes to remove any end-of-roll marks

   p. Seal edges of mat by rolling a 4-inch to 8-inch strip along joint

   q. Check surface after each pass and make corrections as needed

   r. Park roller at an angle if you must park on mat

9. b, d, e, g, j

ANSWERS TO TEST

10. Answer should include any five of the following

    a. Avoid slopes or inclines when possible

    b. Operate up and down the slope, not across

    c. Select proper gear before starting on the slope

    d. Do not exceed 5 mph

    e. If your machine has a gearshift, select a low gear; if it has a hydrostatic drive, the speed control should be in the slow travel position

    f. Do not attempt to change gear selection while traveling on a grade

    g. If stopped on an incline, block both rolls front *and* rear

11. Evaluated to the satisfaction of the instructor

12. Evaluated to the satisfaction of the instructor

13. Performance skills evaluated to the satisfaction of the instructor

DOZER
UNIT IV

UNIT OBJECTIVE

After completing this unit, the student should be able to operate a dozer safely and effectively to perform basic, intermediate, and difficult jobs. This knowledge will be shown by completing job sheets and unit test with a minimum score of 85 percent.

SPECIFIC OBJECTIVES

After completing this unit, the student should be able to

1. Match terms associated with dozers to their correct definitions.
2. Select from a list uses of dozers in highway maintenance.
3. Label basic parts of a dozer.
4. Identify controls on a typical dozer.
5. Match dozer controls to their correct functions.
6. Match accessories used on or with dozers to their correct functions.
7. State safety precautions for operating a dozer.
8. State suggestions for effective dozer operations.
9. State safety procedures for working on a slope.
10. Arrange in order procedures for building a stockpile.
11. Demonstrate the ability to
    a. Perform prestart inspection and maintenance procedures on a dozer.
    b. Service a dozer.
    c. Start, warm up, operate, and shut down a dozer.
    d. Winch a truck stuck in mud.
    e. Use a dozer to pull a roller.
    f. Perform rough ditching and spreading.
    g. Move a large boulder.
    h. Perform ripping operations.
    i. Place riprap.

OBJECTIVE SHEET

j. Push down trees.

k. Cut and build a gentle slope bench.

l. Perform excavation work in a confined area.

m. Use dozer in unstable soils.

n. Perform finish work.

DOZER
UNIT IV

SUGGESTED ACTIVITIES

I. Suggested activities

A. Order film to supplement unit--*Multiple Choice*. Color, 16mm, 24 minutes, Modern Talking Picture Service, Inc., n.d. Available from Caterpillar Film Library, Modern Talking Picture Service, Inc., 1687 Elmhurst Road, Elk Grove Village, Illinois 60007, 312/593-3250. Request #30814 when ordering.

(NOTE: This film contains carefully reconstructed accident situations, which are freeze-framed at the critical moment of judgement. You are asked to spot the hazards.)

B. Provide students with objective sheet.

C. Provide students with information and job sheets.

D. Discuss unit and specific objectives.

E. Discuss information sheet.

F. Demonstrate and discuss procedures outlined in job sheets.

G. Stress to students that manipulation of controls and operation procedures may differ with different models and manufacturers.

H. Stress the range of dozer models, their durability, and the variety of equipment the operator may encounter.

I. Provide an introduction to dozers, including such information as cable and hydraulic controls, steering, and cable drums.

J. Invite resource person to talk about dozer operations and safety.

K. Arrange a field trip for students to observe dozer operations.

L. Provide alternative jobs if those in job sheets are not practical.

M. Give test.

II. Instructional materials

A. Objective sheet

B. Suggested activities

C. Information sheet

SUGGESTED ACTIVITIES

D. Job sheets

1. Job Sheet #1--Perform Prestart Inspection and Maintenance Procedures on a Dozer
2. Job Sheet #2--Service a Dozer
3. Job Sheet #3--Start, Warm Up, Operate, and Shut Down a Dozer
4. Job Sheet #4--Winch a Truck Stuck in Mud
5. Job Sheet #5--Use a Dozer to Pull a Roller
6. Job Sheet #6--Perform Rough Ditching and Spreading
7. Job Sheet #7--Move a Large Boulder
8. Job Sheet #8--Perform Ripping Operations
9. Job Sheet #9--Place Riprap
10. Job Sheet #10--Push Down Trees
11. Job Sheet #11--Cut and Build a Gentle Slope Bench
12. Job Sheet #12--Perform Excavation Work in a Confined Area
13. Job Sheet #13--Use Dozer in Unstable Soils
14. Job Sheet #14--Perform Finish Work

E. Test

F. Answers to test

III. Unit references

A. *Equipment Operator 3 & 2.* Naval Training Command, Washington, D.C.: U.S. Government Printing Office, 1973.

B. *115OC Crawler, Operator's Manual 9-6451.* Racine, Wisconsin: JI Case Company, 1978.

C. Nichols, Herbert L., Jr. *Moving the Earth*, 3rd ed. Greenwich, Connecticut: North Castle Books, 1980.

DOZER
UNIT IV

INFORMATION SHEET

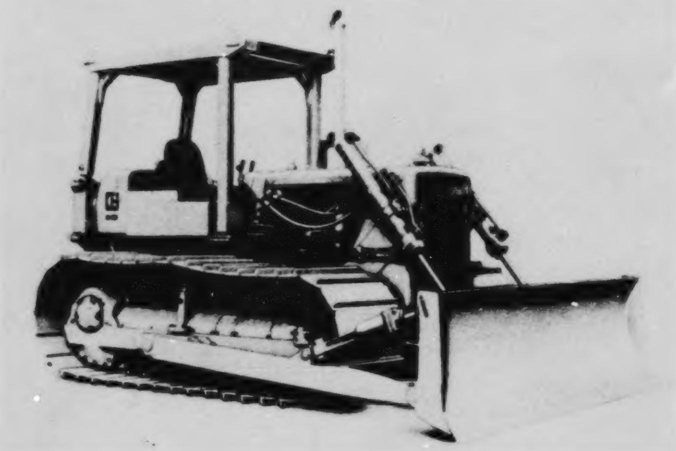
I. Terms and definitions

A. Dozer--Steel-tracked crawler tractor; may be equipped with front-mounted blade and/or ripper or winch; used to move soil and other materials (Figure 1)

(NOTE: There is a great deal about dozer operation that you can learn only from actual experience. For example, to carry the load that you have on the blade, you must anticipate and compensate for the up and down movement of the front of the tractor. This will be awkward at first, but eventually you will be able to raise and lower the blade as automatically as you drive a car.)

EXAMPLE:

FIGURE 1



Courtesy of Caterpillar Tractor Company.

B. Accessory--Attachment used to increase a machine's versatility and effectiveness

C. Pay material--Layer of rock or soil, the value of which justifies excavation

D. Overburden--Soil or rock lying on top of pay material

E. Winch--Power control unit used to pull equipment and to remove stumps

F. Stripping--Removal of overburden or thin layers of pay material

G. Stockpile--Material put into a pile and saved for future use

INFORMATION SHEET

H. Ripping--Loosening hard soil, concrete, or soft rock

I. Unstable soils--Muddy or swampy earth

J. Grouser--Ridge or cleat across a track shoe; improves shoe's grip on the ground

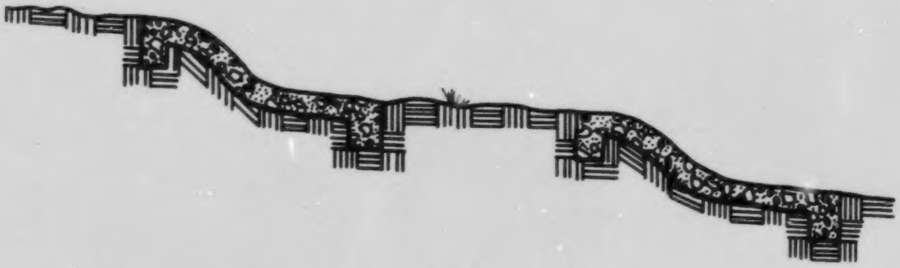
K. Riprap--Mixture of heavy stones used to prevent erosion and make foundations stable

L. Ditch check--Concrete structure used to reduce the slope of steep drainageways (Figure 2)

(NOTE: In Figure 2, two ditch checks have been placed to divide a steep drainageway into two sections of reduced slopes.)

EXAMPLE:

FIGURE 2



M. FOPS--Falling object protective structure

N. Bench--Terrace of level earth or rock

O. Float--Gear position that allows blade to follow contour of ground

II. Uses of dozers in highway maintenance

A. Cleaning right-of-way areas

EXAMPLES: Removing debris from ditches, box culverts, and underneath bridges; clearing brush and trees

B. Digging pits

C. Stockpiling material

INFORMATION SHEET

D. Producing material

EXAMPLE: Digging up material used for stockpile

E. Building ditch checks

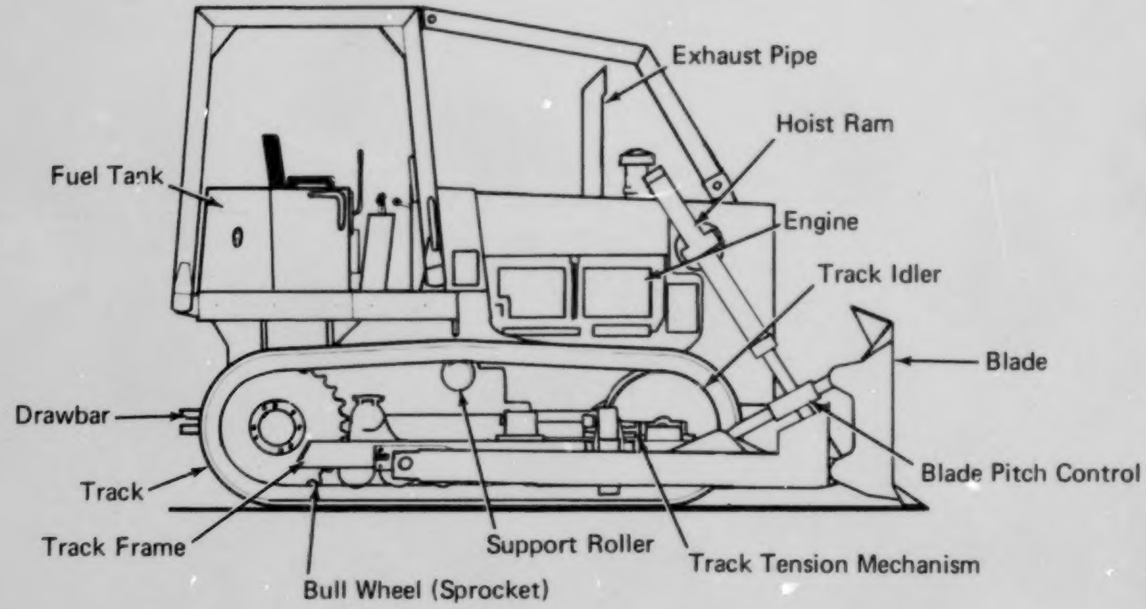
F. Clearing log drifts

G. Removing snow drifts

H. Placing riprap

III. Basic parts of a dozer (Job Sheet #2; Figure 3)

FIGURE 3


Exhaust Pipe
Hoist Ram
Fuel Tank
Engine
Track Idler
Blade
Drawbar
Blade Pitch Control
Track
Track Frame
Support Roller
Track Tension Mechanism
Bull Wheel (Sprocket)

Courtesy of JI Case, a Tenneco Company.

INFORMATION SHEET

IV. Controls on a typical dozer (Job Sheet #3; Figures 4 and 5)

FIGURE 4

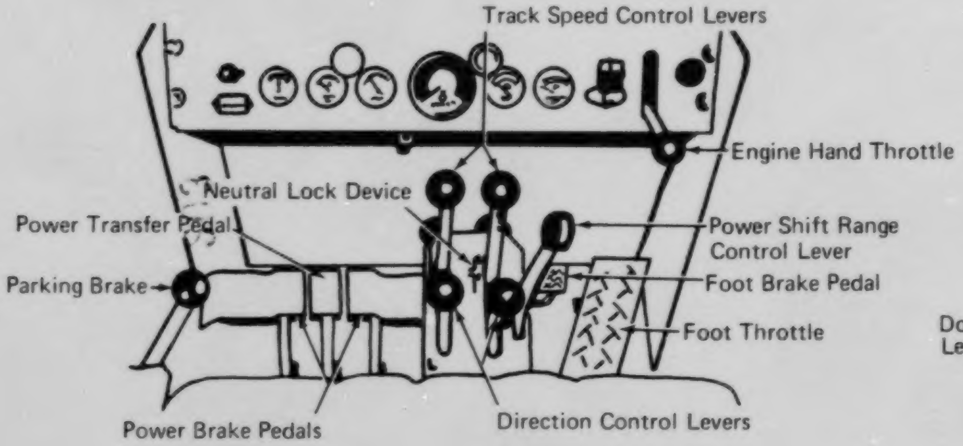
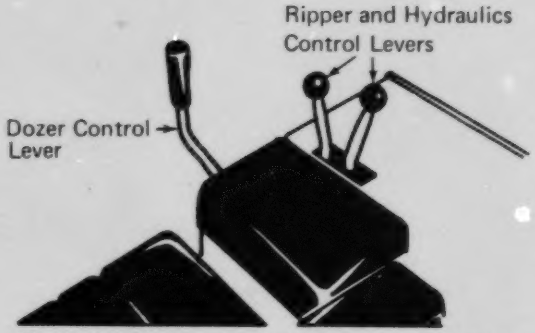

Track Speed Control Levers
Engine Hand Throttle
Neutral Lock Device
Power Transfer Pedal
Power Shift Range Control Lever
Parking Brake
Foot Brake Pedal
Foot Throttle
Power Brake Pedals
Direction Control Levers

FIGURE 5


Ripper and Hydraulics Control Levers
Dozer Control Lever

Equipment Control Levers--Located to Right of Driver's Seat

Courtesy of JI Case, a Tenneco Company.

INFORMATION SHEET

V. Functions of dozer controls (Job Sheet #3)

(NOTE: Controls will vary with manufacturer and model. Study the operator's manual for each machine you operate. Some models are equipped with a decelerator device, which will temporarily decelerate engine speed while the throttle is fully engaged. Controls described here and in Section IV are for a Case 1450 dozer.)

A. Hand throttle--Governs engine speed; raise to increase, lower to decrease

B. Foot throttle--Increases engine speed when depressed

C. Neutral lock device--Locks transmission in neutral position

(NOTE: Starter will operate only when neutral lock device is in lock position.)

D. Direction control levers--Each lever controls forward or reverse direction of one track

(NOTE: Each lever operates independently of the other.)

E. Power shift range control lever--Controls high-range and low-range transmission speeds

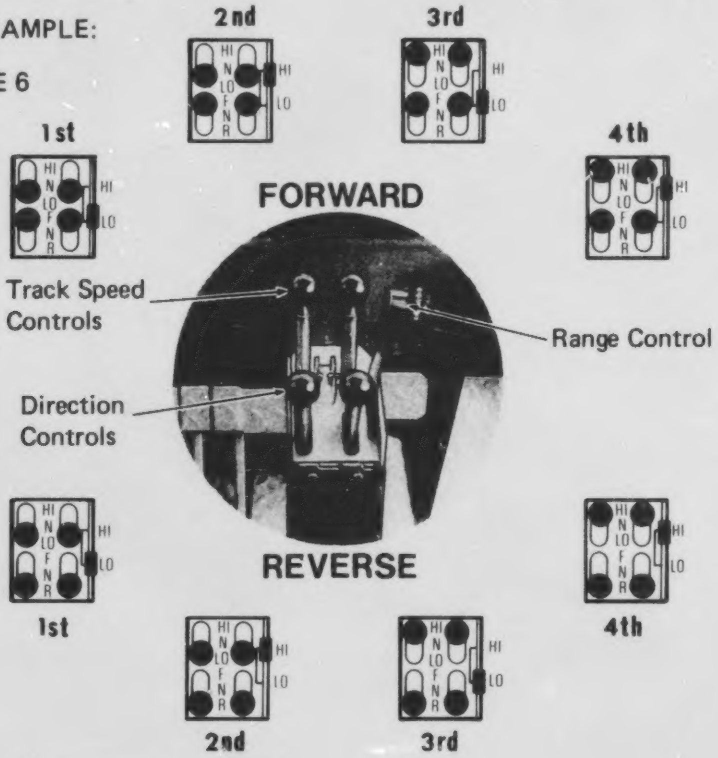
INFORMATION SHEET

F. Track speed control levers--Each lever separately controls speed of one track (Figure 6)

(NOTE: Each lever operates independently of the other. The power shift range control lever and the track speed control levers are operated together to select gears.)

EXAMPLE:

FIGURE 6


2nd
3rd
1st
4th
HI
N
LO
F
N
R
HI
LO
FORWARD
Track Speed Controls
Range Control
Direction Controls
REVERSE
1st
4th
2nd
3rd

Courtesy of JI Case, a Tenneco Company.

G. Parking brake--Secures dozer when parked

H. Foot brake pedal--Manually brakes both tracks at the same time without interrupting track power

I. Power brake pedals--Steer and stop dozer

(NOTE: Depress right or left pedal to steer the dozer. Push both pedals down to interrupt power to both tracks and stop the dozer.)

J. Power transfer pedal--Interrupts power to tracks

(NOTE: The power transfer pedal can be "feathered" to engage or disengage the clutches gradually. When pushed all the way down, it will stop the machine.)

INFORMATION SHEET

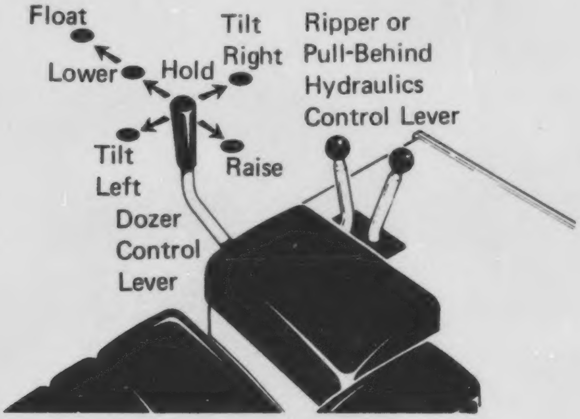
K. Decelerator pedal (not shown)--Decreases speed quickly

(NOTE: Some models are equipped with a decelerator pedal, which will slow the engine when depressed. When the pedal is released, engine will return to hand throttle setting.)

L. Dozer control lever–Raises, lowers, holds, floats, and tilts dozer blade (Figure 7)

EXAMPLE:

FIGURE 7

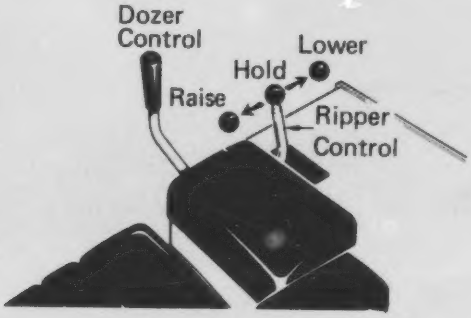

Float
Lower
Hold
Tilt Right
Ripper or Pull-Behind Hydraulics Control Lever
Tilt Left
Raise
Dozer Control Lever

Courtesy of JI Case, a Tenneco Company.

M. Ripper and hydraulics control levers--Control ripper and hydraulic accessories (Figure 8)

EXAMPLE:

FIGURE 8


Dozer Control
Lower
Hold
Raise
Ripper Control

Courtesy of JI Case, a Tenneco Company.

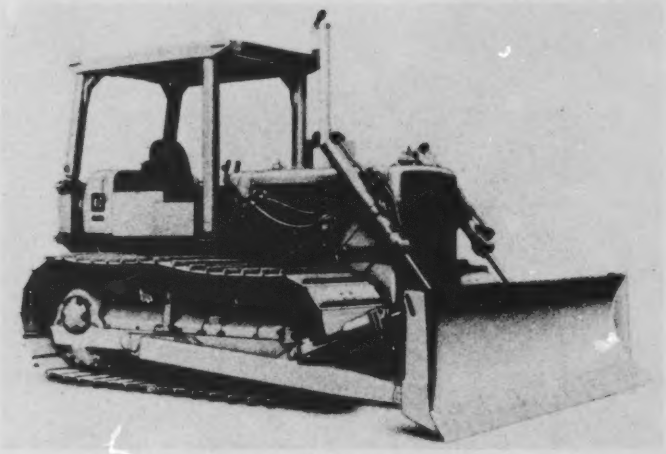
INFORMATION SHEET

VI. Accessories used on or with dozers (Job Sheets #4-#11; Figures 9-12)

A. Straight blade--Used to dig pits and trenches, level, clear brush and trees, move earth and rocks, and stockpile (Job Sheets #7-#10)

EXAMPLE:

FIGURE 9

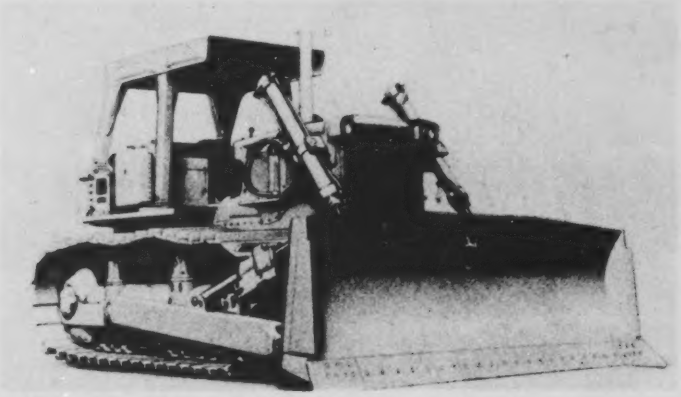


Courtesy of Caterpillar Tractor Company.

B. Angle blade--Used to backfill trenches, sidecast material into ditches, and to shape roads (Job Sheet #6)

EXAMPLE:

FIGURE 10



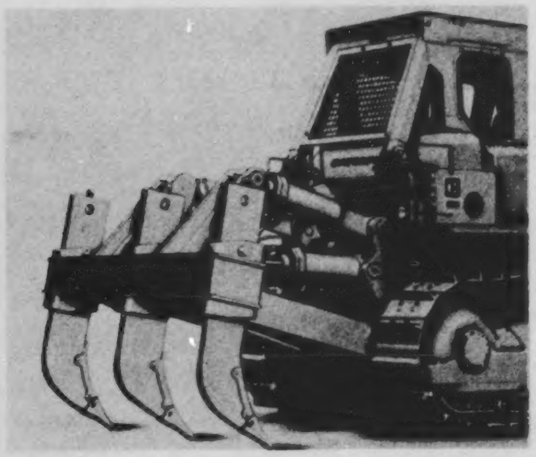
Courtesy of Caterpillar Tractor Company.

INFORMATION SHEET

C. Multiple-shank ripper--Used to loosen asphalt, pavement, sandstone, or other semisolid materials (Job Sheet #8)

EXAMPLE:

FIGURE 11

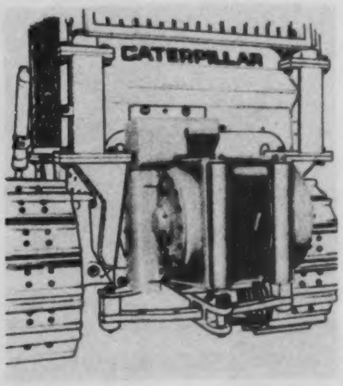


Courtesy of Caterpillar Tractor Company.

D. Winch--Used to pull equipment, trees, and stumps (Job Sheet #4)

EXAMPLE:

FIGURE 12



Courtesy of Caterpillar Tractor Company.

INFORMATION SHEET

VII. Safety precautions for operating a dozer

(NOTE: Dozers are complex and powerful machines that require complete attention for proper control during operation.)

A. Read operator's manual thoroughly: know your machine

B. Keep machine clean

C. Wear clothing and safety items required by job conditions

D. Keep all safety guards and covers secure and in place

E. Do not move machine until you are sure personnel and obstructions are cleared from area

F. Check all safety devices before moving machine

G. Mount and dismount properly, using handholds and steps

H. Do not allow anyone to ride on dozer

I. Know traffic pattern of job and obey spotter

J. Keep work area as level as possible

K. Do not leave engine running unattended

L. Avoid operating too close to banks or overhangs

M. Comply with all local, state, and federal regulations when working around overhead or underground power lines

N. Watch for survey flags indicating power and gas lines and buried pipes

O. Park on level ground whenever possible

P. Travel with the blade low

Q. Lower blade to ground when parking

R. Wear seat belt at all times

VIII. Suggestions for effective dozer operations (Job Sheets #1, #4-#14)

(NOTE: For most efficient operation, the depth of cut should be gauged to push the most material possible without losing speed by spinning the tracks or lugging the engine. The distance the material is pushed should also be kept to a minimum.)

A. Perform prestart inspection and maintenance procedures

B. Keep equipment clean

C. Make sure dozer is operating effectively

INFORMATION SHEET

D. Plan operations before starting

E. Keep cycle from digging area to depositing area as short as possible

F. Observe all safety rules and regulations

G. Dig and carry material downgrade whenever possible

H. Make three or four short passes to build big loads

I. Cut just to depth that dozer can handle on each pass

(NOTE: Do not overload the dozer.)

J. When transporting dozer, cover rain cap to protect turbocharger

(NOTE: If rain cap is left uncovered, wind will turn blades and overheat turbocharger unit.)

IX. Safety procedures for working on a slope (Job Sheet #11)

(CAUTION: Dozers tip over easily.)

A. Work from bottom to top of slope

B. Keep blade at a ninety-degree angle to ground

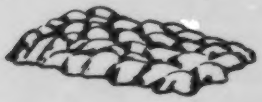
C. Travel with blade upslope

X. Procedures for building a stockpile (Figures 13-17)

A. Truck dumps several loads of material

EXAMPLE:

FIGURE 13



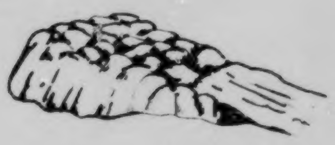
From *Moving the Earth*, used with permission of North Castle Books.

INFORMATION SHEET

B. Dozer builds a ramp

EXAMPLE:

FIGURE 14



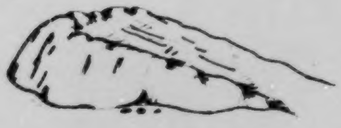
From *Moving the Earth*, used with permission of North Castle Books.

C. Truck dumps at bottom of ramp, and dozer pushes material up

(NOTE: The dozer should operate in straight lines, forward, and reverse. The dozer backs down the ramp. It does not turn around at the top of the pile.)

EXAMPLE:

FIGURE 15



From *Moving the Earth*, used with permission of North Castle Books.

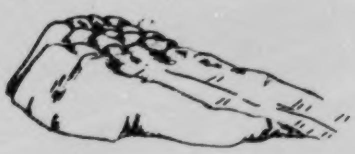
D. Truck dumps on either side of ramp to widen pile

E. Truck dumps at top of ramp to build pile higher

(NOTE: Until there is sufficient room to turn around, trucks must also back down. Grades should not be so steep that trucks strain to operate when they dump on top. Both trucks and dozers must avoid ramp edge.)

EXAMPLE:

FIGURE 16



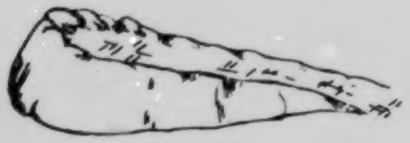
From *Moving the Earth*, used with permission of North Castle Books.

INFORMATION SHEET

F. Dozer completes stockpile

EXAMPLE:

FIGURE 17



From *Moving the Earth*, used with permission of North Castle Books.

DOZER
UNIT IV

JOB SHEET #1--PERFORM PRESTART INSPECTION AND MAINTENANCE PROCEDURES ON A DOZER

I. Equipment and materials

A. Dozer

B. Operator's manual

C. Engine oil

D. Engine coolant

E. Hydraulic fluid

F. Fuel

G. Lubricants

H. Grease gun

I. Rags

II. Procedure

(NOTE: Deficiencies should be corrected immediately or reported to the proper authority. Do not operate defective equipment.)

A. Walk around dozer, making a visual inspection for leaks and broken, worn, or missing parts

B. Check engine oil level; add or change oil if needed

C. Check engine coolant level; add coolant if needed

D. Check hydraulic reservoir level; add fluid if needed

E. Check fuel level; fill tank if necessary

F. Check battery connections for tightness and corrosion

G. Check battery electrolyte level; add water if needed

H. Check air cleaner; remove and clean filter if necessary

I. Check brakes

J. Check track extension; adjust if necessary

K. Clean grill screen

JOB SHEET #1

L. Clean brush shields on both sides

M. Check splitter gearbox oil level; add oil if needed

N. Clean all grease fittings and lubricate according to specifications in operator's manual

O. Check hydraulic system for leaking lines and connections, bent or kinked lines, and lines rubbing against other parts

P. Check drive belts for tightness

Q. Check electrical wire connections and insulation

R. Clean windshield

S. Check gauges

T. Check foot pedals for proper functioning

U. Check levers and controls for proper functioning

V. Remove trash

W. Check lights

X. Check safety devices

   1. Lights
   2. Backup warning
   3. Horn
   4. Fire extinguisher
   5. First-aid kit

Y. Check major components

   1. Blade
   2. Accessories if any

DOZER
UNIT IV

JOB SHEET #2--SERVICE A DOZER

I. Equipment and materials

- A. Dozer
- B. Operator's manual
- C. Tool kit
- D. Air supply
- E. Grease gun
- F. Lubricants
- G. Cleaning solvents
- H. Rags
- I. Water
- J. Engine coolant
- K. Engine oil
- L. Hydraulic fluid
- M. Transmission fluid
- N. Brake fluid
- O. Tire pressure gauge
- P. Fuel

II. Procedure

(NOTE: Follow departmental preventive maintenance program when servicing equipment. Refer to operator's manual for lubrication chart and for servicing specific components and attachments.)

A. Visually inspect for leaks and broken, worn, or missing parts

(NOTE: Major repairs and replacements should be reported to the proper authority and completed by a trained mechanic.)

B. Check engine oil level, filter, lines, and hoses; add engine oil if needed

JOB SHEET #2

C. Check engine coolant level, radiator cap, hose, and radiator; add coolant if needed

(CAUTION: Do not remove radiator cap unless engine is cool; then, open cap slowly to release pressure.)

D. Clean air filter; replace if necessary

E. Check fuel level, fuel filters, and sediment bowl (where applicable); fill fuel tank if necessary

F. Check battery electrolyte level, battery cables, and connectors; add water if needed

(CAUTION: Keep sparks and fire away from battery.)

G. Check exhaust system for loose connections and holes

H. Check hydraulic fluid level, filters, hose, lines, and fittings; look for leaks; add fluid if required

I. Check transmission fluid level; add fluid if needed

J. Check transmission pressure line filter and breather

K. Check splitter gearbox; add oil if needed

L. Check brake adjustment and condition; adjust if necessary

M. Check brake master cylinder fluid level; fill if necessary

N. Check clutch adjustment; adjust if necessary

O. Check drive belts for tension and wear; adjust or replace if necessary

P. Check wiring, insulation, and connections

Q. Clean and lubricate grease fittings according to operator's manual

R. Check track tension; adjust if necessary

S. Check condition of tracks; clean out excessive dirt

T. Check track drive chains and pads

U. Check all safety devices; repair if necessary

V. Check major components and/or accessories

DOZER
UNIT IV

JOB SHEET #3--START, WARM UP, OPERATE, AND SHUT DOWN A DOZER

I. Equipment

A. Dozer

B. Operator's manual

II. Procedure

A. Review starting procedures in manual

B. Apply lock and brakes

C. Lock transmission lever in neutral

D. Turn disconnect switch to ON

E. Adjust governor control lever to proper starting position

F. Engage starter

(NOTE: See operator's manual for cold-weather starting procedure.)

(CAUTION: Never operate starter more than thirty seconds at a time. If engine fails to start, wait two to five minutes before trying again.)

G. Allow engine to warm up

(NOTE: Allow to warm five minutes in summer, ten to fifteen minutes in winter.)

H. Determine that all gauges are functioning properly

I. Pull blade control lever to raise and lower blade

J. Unlock brakes

K. Depress accelerator pedal and move speed selector lever to first forward gear

L. Manipulate controls to be sure all components are operating properly

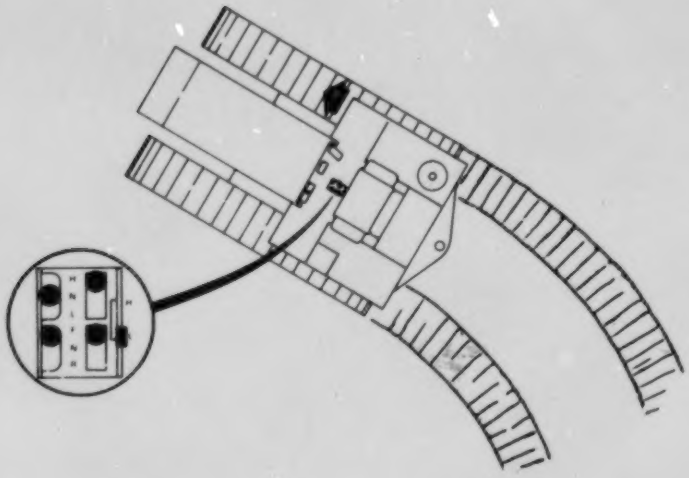
M. Operate at reduced engine speeds to familiarize yourself with the dozer

JOB SHEET #3

N. Make a gradual left turn

(NOTE: A gradual turn is made by shifting a track speed lever to neutral while driving forward. To turn left, shift the left track speed control lever to neutral. The driving track on the right side will gradually turn the dozer to the left. See Figure 18.)

FIGURE 18



Courtesy of JI Case, a Tenneco Company.

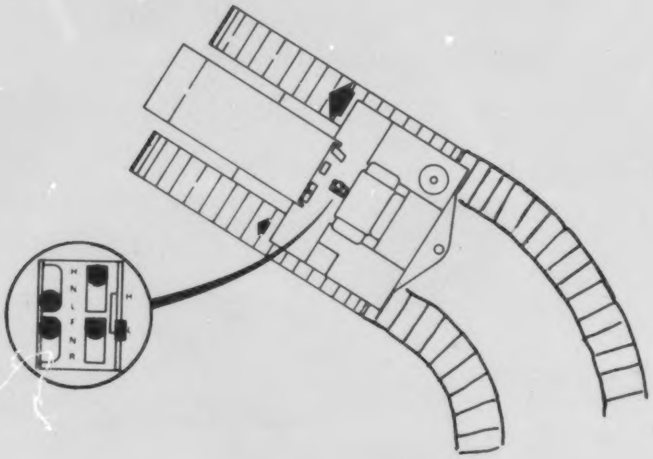
O. Make a gradual right turn

JOB SHEET #3

P. Make a power turn to the left

(NOTE: The power turn is made by shifting one of the track speed controls to low while the other is in high. To turn left, shift the left track speed control to low and shift the right control to high. The dozer will turn left with full power to both tracks. Figure 19)

FIGURE 19



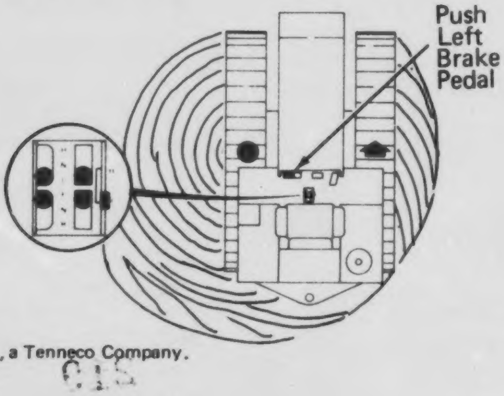
Courtesy of JI Case, a Tenneco Company.

Q. Make a power turn to the right

R. Make a brake turn to the left

(NOTE: The brake turn is made by using the power brakes individually. To turn left, depress the left pedal. See Figure 20.)

FIGURE 20



Courtesy of JI Case, a Tenneco Company.

JOB SHEET #3

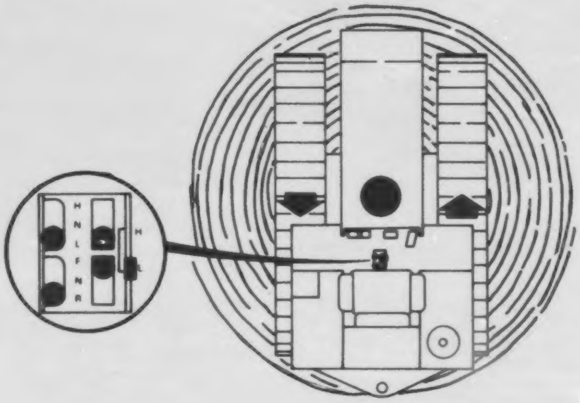
S. Make a brake turn to the right

(NOTE: The right or left power brake pedal may be used for slight direction changes when traveling in high range at maximum throttle. Use caution; do not push hard. Do not attempt this technique until you have some practice operating the dozer.)

T. Make counterrotation turn

(NOTE: The counterrotation turn is very useful in confined areas. Place both track speed control levers in low; and shift one direction control lever forward, the other to reverse. See Figure 21.)

FIGURE 21



Courtesy fo JI Case, a Tenneco Company.

U. Reduce engine speed

V. Move speed selector lever to neutral and apply brake

W. Lock speed selector lever in neutral

X. Apply parking brake and lock

Y. Dismount bulldozer properly, and make final visual check

DOZER
UNIT IV

JOB SHEET #4--WINCH A TRUCK STUCK IN MUD

I. Equipment

- A. Dozer with winch attachment
- B. Truck
- C. Chain
- D. Recommended safety equipment
    - 1. Hard hat
    - 2. Hard-toed shoes
    - 3. Ear plugs
    - 4. Gloves
    - 5. Goggles (if needed)
    - 6. Close-fitting clothing

II. Procedure

(NOTE: Before starting procedure, observe stuck vehicle and determine the most efficient method of completing the job.)

- A. Mount dozer, using steps and grab irons
- B. Sit in operator's seat and secure safety belt
- C. Raise blade just enough to clear obstacles
- D. Release parking brakes and transmission lock
- E. Select first forward gear; travel to truck
- F. Select first reverse gear; back dozer into position for attaching chain to truck
- G. Place transmission in neutral and lock
- H. Set both track brakes
- I. Release winch-jaw clutch and set brake with a slight drag
- J. Release seat belt and dismount, using steps and grab irons
- K. Have truck driver attach chain to truck
- L. Release winch hook

JOB SHEET #4

M. Pull cable to truck and attach to chain

N. Inform truck driver of the procedures you are going to use to free truck

O. Remount dozer, using steps and grab irons

P. Sit in operator's seat; secure seat belt

Q. Reengage winch jaws; take up slack in line

R. Increase engine rpm and apply power

(NOTE: When power is applied, truck driver should have his vehicle in gear with wheels driving.)

S. Observe winch to be sure cable is feeding onto drum correctly

(NOTE: The truck may come out, or the dozer may be pulled toward the truck. If the dozer is pulled toward the truck, it is sometimes possible to place the machine in gear and spin down until a bank is created behind the dozer; use this bank for leverage. If this method does not work, it will probably be necessary to anchor the dozer by using blocks or a chain attached to a solid object.)

T. Release brake; place winch in locked position and release transmission lock

U. Place dozer in first forward gear and increase engine rpm

V. Continue pulling until truck is completely clear of mud

(NOTE: Stop both vehicles when they are free of the mud.)

W. Select first reverse gear; back toward truck until there is enough slack to unhook cable

X. Have truck driver remove cable and chain from truck

Y. Place winch in gear--observing to see that cable is feeding onto drum correctly--until all cable is on drum

Z. Disconnect winch and secure machine

AA. Place transmission in locked position, lower blade to ground, set parking brake, and shut off machine

BB. Dismount machine, using steps and grab irons; secure cable by placing cable hook in eye

CC. Tighten cable

DOZER
UNIT IV

JOB SHEET #5--USE A DOZER TO PULL A ROLLER

(NOTE: Operator's instructions are to use dozer to pull roller and penetrate no more than one inch into material.)

I. Equipment and materials (Figure 22)

  A. Roller

  B. Dozer with drawbar

  C. Recommended safety equipment

    1. Hard hat

    2. Hard-toed shoes

    3. Ear plugs

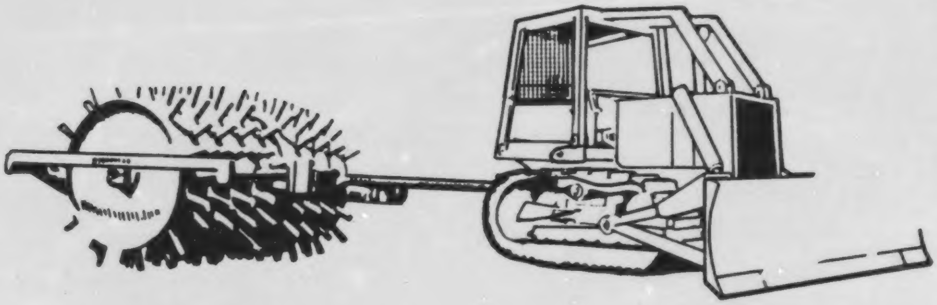
    4. Gloves

    5. Goggles (if needed)

    6. Close-fitting clothing

  D. Pad to be compacted--Area 50' x 100' with a lift of moist clay one foot deep, or equivalent

FIGURE 22



JOB SHEET #5

II. Procedure

A. Mount dozer, using steps and grab irons

B. Sit in operator's seat and secure seat belt

C. Raise blade off ground to clear obstacles

D. Release brake and transmission lock

E. Select travel gear and move dozer to where roller is parked

F. Align dozer with roller

G. Select first reverse gear and slowly move backwards until hitch connection in drawbar lines up with hitch connection in tongue of roller

H. Stop dozer

I. Depress brake (and decelerator if dozer is so equipped)

J. Place transmission in neutral position

K. Dismount; place and secure hitch pin through drawbar of dozer and tongue of roller

L. Mount dozer and secure seat belts

M. Select first forward gear

N. Observe forward speed and align right side of roller with right side of pad

O. Travel straight ahead the length of pad

P. Maintain low engine speed to provide proper speed but to avoid engine lugging

Q. Approach end of pad, and gradually turn left

(NOTE: Care must be taken during turn to avoid kicking out material on right side of tracks and causing irregularities on pad.)

R. Align roller with right edge of pad end

S. Select first reverse gear, and slowly move backward over area that was missed when turn was made

(NOTE: When backing, turn in seat and observe rearward movement; observe when bottom of roller drum reaches edge of pad.)

T. Select first forward gear, and slowly move forward

U. Continue this procedure completely around pad, and then proceed to next pass, overlapping one-half of first pass

DOZER
UNIT IV

JOB SHEET #6--PERFORM ROUGH DITCHING AND SPREADING

I. Equipment

A. Dozer equipped with angle blade

B. Recommended safety equipment

1. Hard hat
2. Hard-toed shoes
3. Ear plugs
4. Gloves
5. Goggles (if needed)
6. Close-fitting clothing

II. Procedure

A. Mount dozer, using steps and grab irons

B. Sit in operator's seat and secure seat belt

C. Raise blade to travel position

D. Release brake and transmission lock

E. Shift to travel gear; move dozer to work area

F. Select first forward gear; begin tilting down leading cutting edge

G. Lower blade to ground and begin ditch

H. Raise blade slightly to allow machine to level out as dozer tracks walk into the cut

I. As machine levels out, lower blade to continue ditching

J. Angle blade so that material is sidecast up sides of ditch

K. After one side of ditch is cut, turn dozer around and repeat cycle on return pass

DOZER
UNIT IV

JOB SHEET #7--MOVE A LARGE BOULDER

I. Equipment

   A. Dozer

   B. Large boulder

   C. Recommended safety equipment

      1. Hard hat

      2. Hard-toed shoes

      3. Ear plugs

      4. Gloves

      5. Goggles (if needed)

      6. Close-fitting clothing

II. Procedure

   A. Mount dozer, using steps and grab irons

   B. Sit in operator's seat and secure seat belt

   C. Raise blade off ground to clear obstacles

   D. Release brake and transmission lock

   E. Select first forward gear

   F. Approach boulder, and tilt blade to make contact with ground at edge of boulder

   G. Push boulder at full power to dislodge it

   H. Once boulder has turned, stop and reverse direction

   I. Stop and select first forward gear; line up blade on boulder

   J. Lower blade to ground and push boulder out of the way

   K. If boulder is too large to push all at once, line up dozer on one end; push forward and lift blade slowly

      (NOTE: The boulder should roll out on one end.)

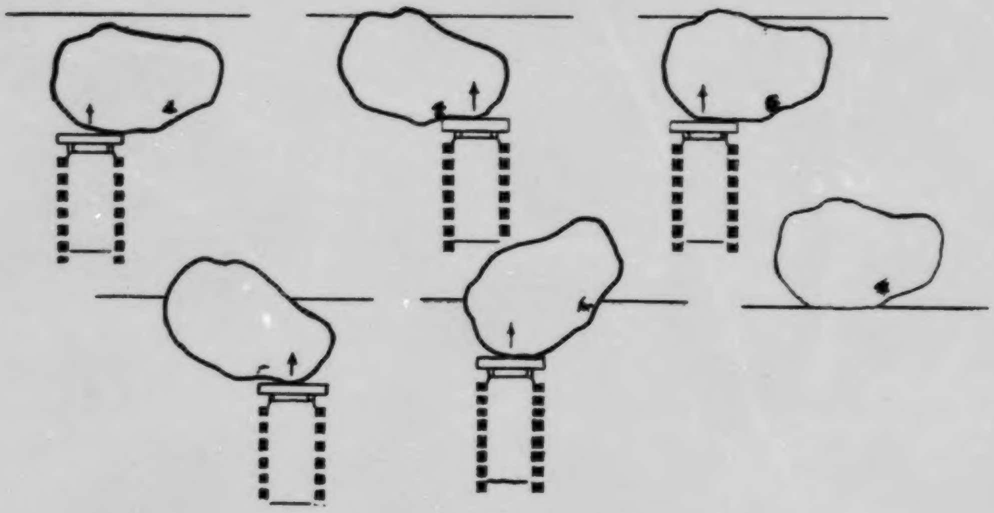
   L. Reverse direction and line up on other end

JOB SHEET #7

M. Select first forward gear and lower blade to ground on other end; to roll end out, push forward and raise blade at same time

(NOTE: If stone is too large to move by direct pushing, it can be pushed first on one side and then on the other side. See Figure 23.)

FIGURE 23



From *Moving the Earth*, used with permission of North Castle Books.

N. Continue this procedure until boulder is removed

DOZER
UNIT IV

JOB SHEET #8--PERFORM RIPPING OPERATIONS

I. Equipment

A. Dozer with multiple ripper attachment

B. Recommended safety equipment

1. Hard hat
2. Hard-toed shoes
3. Ear plugs
4. Gloves
5. Goggles (if needed)
6. Close-fitting clothing

II. Procedure

A. Mount dozer, using steps and grab irons

B. Sit in operator's seat and secure seat belt

C. Pull throttle to high engine speed and decelerate with decelerator pedal if dozer is so equipped

D. Raise blade to clear obstructions

E. Release brake and transmission lock; select travel gear

F. Release pressure on decelerator pedal if dozer is so equipped

G. Travel to area to be ripped

H. Select first forward gear; begin lowering rippers as you approach work area

(NOTE: Use hand control or foot pedals to lower rippers.)

I. Lower rippers into material until engine begins to lug and dozer tracks start to spin

(NOTE: Never try to steer dozer with rippers lowered.)

J. Raise rippers to ease strain on machine and rippers

(NOTE: To aid in breaking up materials, some operators prefer to raise and lower the ripper slightly on the move.)

JOB SHEET #8

K. Raise ripper to full UP and decelerate engine as dozer reaches end of area

L. Place transmission out of first forward gear to first reverse gear

M. Return to starting area, being careful to look behind and watch where you are going

N. Repeat cycle until area is ripped to the satisfaction of the instructor

DOZER
UNIT IV

JOB SHEET #9--PLACE RIPRAP

I. Equipment and materials

A. Dozer

B. Dump truck

C. River or creek site

D. Riprap

E. Recommended safety equipment

1. Hard hat
2. Hard-toed shoes
3. Ear plugs
4. Gloves
5. Goggles (if needed)
6. Close-fitting clothing

II. Procedure

(NOTE: Riprap is dumped at the top of the slope. The dozer pushes it down to the river or creek bed.)

A. Mount dozer, using steps and grab irons

B. Sit in operator's seat and secure seat belt

C. Raise blade off ground to clear obstacles

D. Release brake and transmission lock

E. Select travel gear; move dozer to work area

F. Lower blade

G. Push load over edge and down slope to water line

(NOTE: Keep blade at a 90° angle to the ground. If the slope is too steep for safe operation, push the load over and let it roll down. Do not drive dozer over riprap.)

H. Back up the slope and over the top, leaving room for truck to dump another load

JOB SHEET #9

I. Push load down slope to meet first load

J. Continue until riprap is laid from bottom to top of slope

DOZER
UNIT IV

JOB SHEET #10--PUSH DOWN TREES

I. Equipment

  A. Dozer equipped with FOPS

  B. Recommended safety equipment

    1. Hard hat

    2. Hard-toed shoes

    3. Ear plugs

    4. Gloves

    5. Goggles (if needed)

    6. Close-fitting clothing

II. Procedure for small and medium-sized trees

(NOTE: Pushing down trees is dangerous. Never use an open dozer--one without a protective cab--to push down a tree.)

  A. Mount dozer, using steps and grab irons

  B. Sit in operator's seat and secure safety belt

  C. Test tree to determine if it will simply push over

    1. Raise blade high

    2. Push on tree

(CAUTION: Branches and limbs are likely to come down on the cab.)

(NOTE: If the tree doesn't push over, the roots will have to be cut according to the following procedures.)

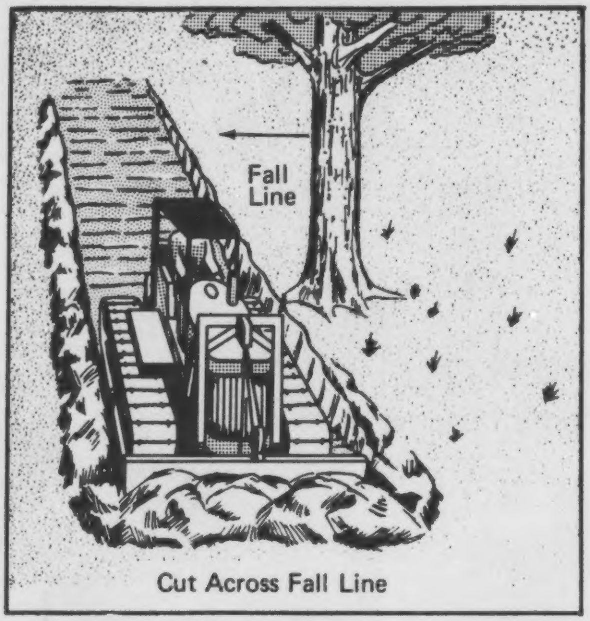
  D. Determine direction in which tree will fall (fall line)

JOB SHEET #10

E. Make a deep cut on the fall-line side, as close to trunk as possible (Figure 24)

(NOTE: This procedure cuts the roots and allows the tree to fall.)

FIGURE 24



Cut Across Fall Line

F. Move to opposite side

G. Raise blade high and SLOWLY push tree over

(NOTE: Branches and limbs may fall on the cab.)

H. Back up and lower blade to root line as tree starts to fall

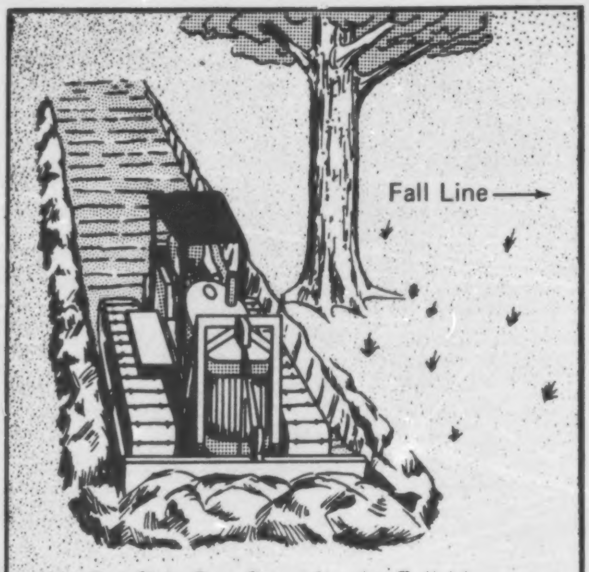
I. Push and raise blade simultaneously to extract roots

JOB SHEET #10

III. Procedure for very large trees

A. Make first cut on the side *opposite* fall line, keeping as close to trunk as possible (Figure 25)

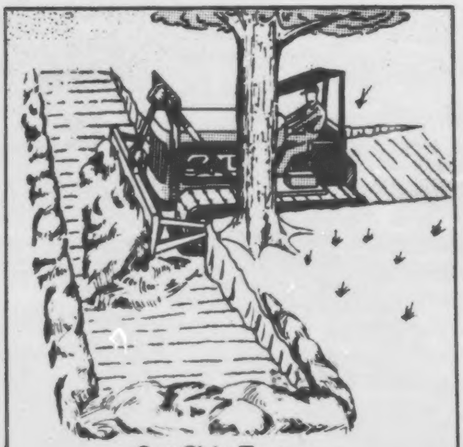
FIGURE 25



Cut Side One Opposite the Fall Line

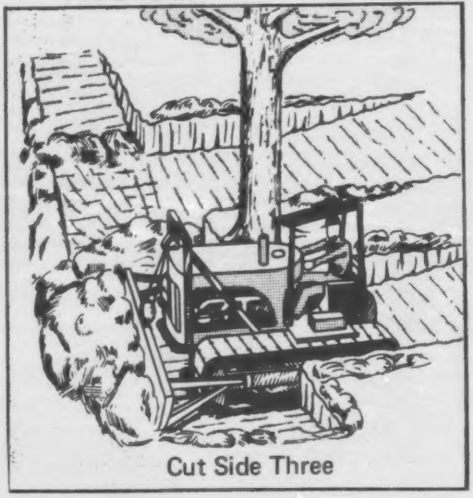
B. Make two cuts at right angles to first, keeping as close to trunk as possible (Figures 26 and 27)

FIGURE 26



Cut Side Two

FIGURE 27



Cut Side Three

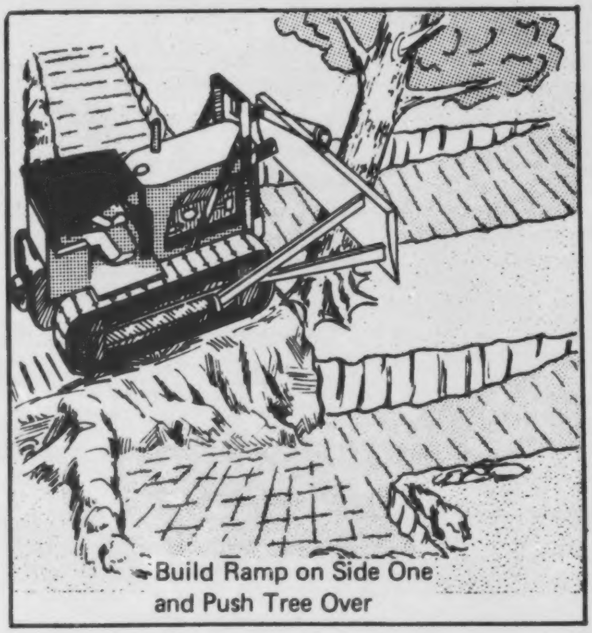
JOB SHEET #10

C. Fill in first cut and build a ramp

(NOTE: The ramp lets the blade reach higher up the trunk, giving it better leverage.)

D. Raise blade high and SLOWLY push tree over (Figure 28)

FIGURE 28


Build Ramp on Side One
and Push Tree Over

E. Back up and lower blade to root line as tree starts to fall

F. Push blade under roots; push and raise simultaneously to extract roots

DOZER
UNIT IV

JOB SHEET #11–CUT AND BUILD A GENTLE SLOPE BENCH

I. Equipment

A. Dozer

B. Recommended safety equipment

1. Hard hat
2. Hard-toed shoes
3. Ear plugs
4. Gloves
5. Goggles (if needed)
6. Close-fitting clothing

II. Procedure

A. Mount dozer, using steps and grab irons

B. Sit in operator's seat and secure seat belt

C. Start slowly; then open throttle

(NOTE: If dozer is equipped with decelerator, pull throttle to high engine speed and decelerate with decelerator pedal.)

D. Raise blade to clear obstructions

E. Release brake and transmission lock; select travel gear

F. Release pressure on decelerator pedal if dozer is so equipped

G. Select first forward gear; travel to top of hill

H. Approach slope stakes on top of bench

I. Lower blade and begin cutting down the hill, maintaining slope ratio

J. When blade becomes full and dozer begins to stall, raise blade and lose the material

K. Place machine in reverse and return to top of hill

L. Shift into forward and lower blade; continue cutting, maintaining proper slope ratio

M. When blade becomes full, raise gradually so that front of machine will level

JOB SHEET #11

N. Lower blade to maintain level grade

O. As machine begins to level out, lose the material

P. Place dozer in reverse and return to the top of bench

Q. Move dozer over one blade width and continue cycle until bench is cut to proper depth

(CAUTION: When making a cut, be sure to maintain slope ratio.)

DOZER
UNIT IV

JOB SHEET #12--PERFORM EXCAVATION WORK IN A CONFINED AREA

I. Equipment

- A. Dozer
- B. Area stringline-staked on two sides between obstructions
- C. Recommended safety equipment
  1. Hard hat
  2. Hard-toed shoes
  3. Ear plugs
  4. Gloves
  5. Goggles (if needed)
  6. Close-fitting clothing

II. Procedure

- A. Mount dozer, using steps and grab irons
- B. Sit in operator's seat and secure seat belt
- C. Raise blade to travel position
- D. Release brake and transmission lock
- E. Start slowly; then open throttle

  (NOTE: If dozer is equipped with decelerator, set throttle to high engine speed and decelerate engine with foot pedal.)
- F. Shift to travel gear
- G. Travel to area to be excavated
- H. Line up dozer blade edge on inside of stringline
- I. Lower blade to ground, keeping dozer well back from edge of excavation to allow for ramping down into excavation
- J. Select first forward gear and cut a shallow lift of material
- K. When blade becomes full, raise to ground level and push material outside of excavation

  (NOTE: Ride load over undug ground.)

JOB SHEET #12

L. Raise blade and shift to reverse

M. Return to area where blade became full

N. Lower blade to ground; shift to first forward gear

O. Repeat cycle until layer is cut

P. Raise blade gradually to ramp out on opposite end

Q. To maintain a smooth slope, lower blade as tracks begin climbing out

R. Raise blade gradually to lose material

S. Shift to reverse and return to opposite side

T. Continue cycle until proper depth is reached

DOZER
UNIT IV

JOB SHEET #13--USE DOZER IN UNSTABLE SOILS

I. Equipment

   A. Dozer

   B. Recommended safety equipment

      1. Hard hat

      2. Hard-toed shoes

      3. Ear plugs

      4. Gloves

      5. Goggles (if needed)

      6. Close-fitting clothing

II. Procedure

   A. Mount dozer, using steps and grab irons

   B. Sit in operator's seat and secure seat belt

   C. Raise blade to travel position (twelve to eighteen inches off ground)

   D. Release brake and transmission lock

   E. Start slowly; then open throttle

   (NOTE: If dozer is equipped with decelerator, pull hand throttle to full open and decelerate engine with foot pedal.)

   F. Shift to travel gear

   G. Position dozer to one side of muddy area; travel to work area

   H. Downshift to first forward gear

   I. Lower blade to skim just a shallow layer of mud

   J. Dig cautiously to avoid sinking tractor

   (CAUTION: Avoid spinning track. When you lose traction, stop and wait for someone to pull you out.)

   K. Push mud far back

   (NOTE: Mud must be cleared back because the dozer cannot climb on it to make high piles.)

JOB SHEET #13

L. Shift to reverse gear

M. Back dozer to starting position; line up with next pass

N. Shift gears to first forward gear; lower blade to skim mud

O. Position blade approximately one-half the width of previous pass to avoid material spilling off onto completed pass

P. Push material far back, raising blade slightly so that material flows out in an even spread

Q. Shift to reverse gear and travel back to start of area

R. Repeat cycle until area is cleared of mud

DOZER
UNIT IV

JOB SHEET #14--PERFORM FINISH WORK

I. Equipment

- A. Dozer
- B. Recommended safety equipment
  1. Hard hat
  2. Hard-toed shoes
  3. Ear plugs
  4. Gloves
  5. Goggles (if needed)
  6. Close-fitting clothing

II. Procedure

- A. Mount dozer, using steps and grab irons
- B. Sit in operator's seat and secure seat belt
- C. Raise blade to travel position
- D. Release brake and transmission lock
- E. Start slowly; then open throttle

  (NOTE: If dozer is equipped with decelerator, pull throttle to high engine speed and decelerate using foot pedal.)
- F. Travel to work site
- G. Shift to first forward gear
- H. Lower blade to ground, looking ahead of machine for high spots and gullies
- I. Raise or lower blade slightly to maintain a level footing for tractor
- J. Tilt and steer machine to skim material from high spots to low areas
- K. Raise blade gradually to lose material
- L. Shift to reverse and travel back to starting point

JOB SHEET #14

M. Move dozer over one blade width

N. Repeat cycle until area is clean

O. Move machine to edge of area and lower blade

P. Select first reverse gear and place blade in FLOAT position

Q. Back up over area to be smoothed

R. When area has been traversed, raise blade to travel position

S. Select travel gear, and steer dozer to opposite edge

T. Move dozer over three-quarters of blade width

U. Repeat cycle until area is smooth and free of loose dirt, piles, or grouser prints

DOZER
UNIT IV

TEST

NAME ________________________________ SCORE ______________

1. Match terms associated with dozers to their correct definitions. Write the correct numbers in the blanks.

_____a. Muddy or swampy earth

_____b. Mixture of heavy stones used to prevent erosion and make foundations stable

_____c. Removal of overburden or thin layers of pay material

_____d. Attachment used to increase a machine's versatility and effectiveness

_____e. Concrete structure used to reduce the slope of steep drainageways

_____f. Power control unit used to pull equipment and to remove stumps

_____g. Soil or rock lying on top of pay material

_____h. Material put into a pile and saved for future use

_____i. Layer of rock or soil, the value of which justifies excavation

_____j. Ridge or cleat across a track shoe; improves shoe's grip on the ground

_____k. Loosening hard soil, concrete, or soft rock

_____l. Gear position that allows blade to follow contour of ground

_____m. Terrace of level earth or rock

_____n. Falling object protective structure

_____o. Steel-tracked crawler tractor; may be equipped with front-mounted blade and/or ripper or winch; used to move soil and other materials

1. Ditch check
2. Grouser
3. Accessory
4. Unstable soils
5. Stockpile
6. Overburden
7. Stripping
8. Riprap
9. Pay material
10. Winch
11. Ripping
12. FOPS
13. Bench
14. Float
15. Dozer

TEST

2. Select from the following list uses of dozers in highway maintenance. Write an "X" in the blank before each correct answer.

______a. Removing snow drifts

______b. Mowing

______c. Clearing fog drifts

______d. Digging narrow trenches

______e. Cleaning right-of-way areas

______f. Transporting equipment

______g. Placing riprap

______h. Stockpiling material

______i. Laying asphalt material

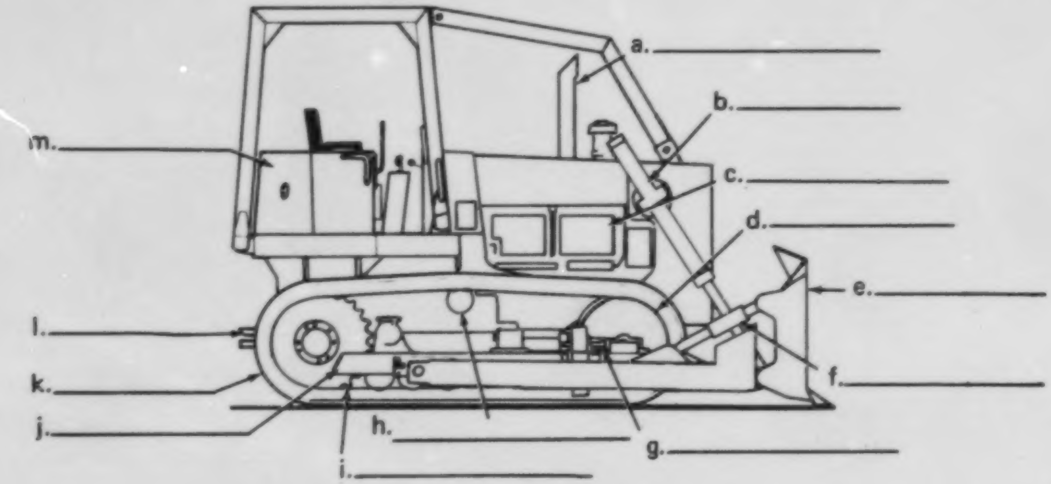
______j. Building ditch checks

______k. Loading

______l. Producing material

______m. Digging pits

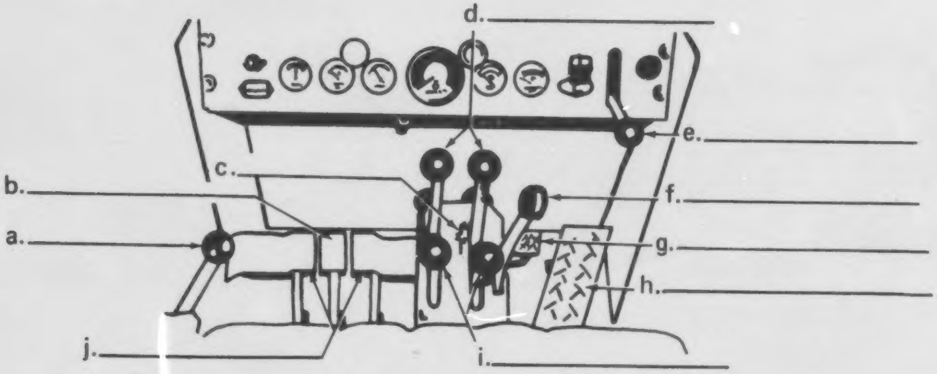
3. Label basic parts of a dozer. Write the correct names in the blanks.

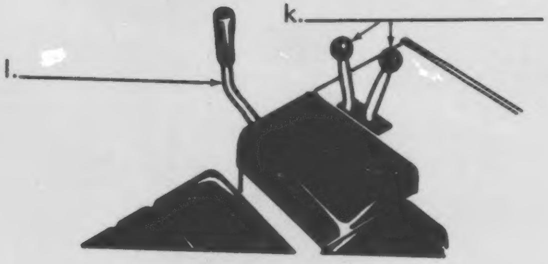


TEST

4. Identify controls on a typical dozer. Write the correct names in the blanks.

Neutral lock device
Track speed control levers
Power transfer pedal
Parking brake
Power shift range control lever
Engine hand throttle
Foot brake pedal
Foot throttle
Direction control levers
Power brake pedals





TEST

5. Match dozer controls to their correct functions. Write the correct numbers in the blanks.

_____a. Each lever controls forward or reverse direction of one track

_____b. Each lever separately controls speed of one track

_____c. Interrupts power to tracks

_____d. Governs engine speed; raise to increase, lower to decrease

_____e. Secures dozer when parked

_____f. Locks transmission in neutral position

_____g. Controls high-range and low-range transmission speeds

_____h. Raises, lowers, holds, floats, and tilts dozer blade

_____i. Increases engine speed when depressed

_____j. Control ripper and hydraulic accessories

_____k. Steer and stop dozer

_____l. Manually brakes both tracks at the same time without interrupting track power

_____m. Decreases speed quickly

1. Power transfer pedal
2. Neutral lock device
3. Dozer control lever
4. Parking brake
5. Power shift range control lever
6. Foot throttle
7. Hand throttle
8. Direction control levers
9. Ripper and hydraulics control levers
10. Track speed control levers
11. Power brake pedals
12. Foot brake pedal
13. Decelerator pedal

6. Match accessories used on or with dozers to their correct functions. Write the correct numbers in the blanks.

_____a. Used to pull equipment, trees, and stumps

_____b. Used to dig pits and trenches, level, clear brush and trees, move earth and rocks, and stockpile

_____c. Used to backfill trenches, sidecast material into ditches, and to shape roads

_____d. Used to loosen asphalt, pavement, sandstone, or other semisolid materials

1. Winch
2. Straight blade
3. Multiple-shank ripper
4. Angle blade

TEST

7. State ten safety precautions for operating a dozer.

a. ______________________________

b. ______________________________

c. ______________________________

d. ______________________________

e. ______________________________

f. ______________________________

g. ______________________________

h. ______________________________

i. ______________________________

j. ______________________________

8. State six suggestions for effective dozer operations.

a. ______________________________

b. ______________________________

c. ______________________________

d. ______________________________

e. ______________________________

f. ______________________________

9. State safety procedures for working on a slope.

a. ______________________________

b. ______________________________

c. ______________________________

10. Arrange in order procedures for building a stockpile. Write a "1" before the first step, a "2" before the second step, and so on.

______a. Dozer completes stockpile

______b. Truck dumps at bottom of ramp, and dozer pushes material up

______c. Dozer builds a ramp

TEST

_____d. Truck dumps several loads of material

_____e. Truck dumps on either side of ramp to widen pile

_____f. Truck dumps at top of ramp to build pile higher

(NOTE: Test question 11 lists the job sheets. They are an important part of this test. If they have not been completed, check with your instructor.)

11. Demonstrate the ability to

    a. Perform prestart inspection and maintenance procedures on a dozer.
    b. Service a dozer.
    c. Start, warm up, operate, and shut down a dozer.
    d. Winch a truck stuck in mud.
    e. Use a dozer to pull a roller.
    f. Perform rough ditching and spreading.
    g. Move a large boulder.
    h. Perform ripping operations.
    i. Place riprap.
    j. Push down trees.
    k. Cut and build a gentle slope bench.
    l. Perform excavation work in a confined area.
    m. Use dozer in unstable soils.
    n. Perform finish work.

DOZER
UNIT IV

ANSWERS TO TEST

1. a. 4
   b. 8
   c. 7
   d. 3
   e. 1
   f. 10
   g. 6
   h. 5
   i. 9
   j. 2
   k. 11
   l. 14
   m. 13
   n. 12
   o. 15

2. a, c, e, g, h, j, l, m

3. a. Exhaust pipe
   b. Hoist ram
   c. Engine
   d. Track idler
   e. Blade
   f. Blade pitch control
   g. Track tension mechanism
   h. Support roller
   i. Bull wheel (sprocket)
   j. Track frame
   k. Track
   l. Drawbar
   m. Fuel tank

4. a. Parking brake
   b. Power transfer pedal
   c. Neutral lock device
   d. Track speed control levers
   e. Engine hand throttle
   f. Power shift range control lever
   g. Foot brake pedal
   h. Foot throttle
   i. Direction control levers
   j. Power brake pedals
   k. Ripper and hydraulics control levers
   l. Dozer control lever

ANSWERS TO TEST

5. a. 8
   b. 10
   c. 1
   d. 7
   e. 4
   f. 2
   g. 5
   h. 3
   i. 6
   j. 9
   k. 11
   l. 12
   m. 13

6. a. 1
   b. 2
   c. 4
   d. 3

7. Answer should include any ten of the following
   a. Read operator's manual thoroughly: know your machine
   b. Keep machine clean
   c. Wear clothing and safety items required by job conditions
   d. Keep all safety guards and covers secure and in place
   e. Do not move machine until you are sure personnel and obstructions are cleared from area
   f. Check all safety devices before moving machine
   g. Mount and dismount properly, using handholds and steps
   h. Do not allow anyone to ride on dozer
   i. Know traffic pattern of job and obey spotter
   j. Keep work area as level as possible
   k. Do not leave engine running unattended
   l. Avoid operating too close to banks or overhangs
   m. Comply with all local, state, and federal regulations when working around overhead or underground power lines

ANSWERS TO TEST

n. Watch for survey flags indicating power and gas lines and buried pipes

o. Park on level ground whenever possible

p. Travel with the blade low

q. Lower blade to ground when parking

r. Wear seat belt at all times

8. Answer should include any six of the following

a. Perform prestart inspection and maintenance procedures

b. Keep equipment clean

c. Make sure dozer is operating effectively

d. Plan operations before starting

e. Keep cycle from digging area to depositing area as short as possible

f. Observe all safety rules and regulations

g. Dig and carry material downgrade whenever possible

h. Make three or four short passes to build big loads

i. Cut just to depth that dozer can handle on each pass

j. When transporting dozer, cover rain cap to protect turbocharger

9. a. Work from bottom to top of slope

b. Keep blade at a ninety-degree angle to ground

c. Travel with blade upslope

10. a. 6 d. 1

b. 3 e. 4

c. 2 f. 5

11. Performance skills evaluated to the satisfaction of the instructor

BACKHOE
UNIT V

UNIT OBJECTIVE

After completing this unit, the student should be able to operate a backhoe safely and effectively. The student should also know how to inspect and service a backhoe. This knowledge will be shown by completing assignment sheet, job sheets, and unit test with a minimum score of 85 percent.

SPECIFIC OBJECTIVES

After completing this unit, the student should be able to

1. Match terms associated with backhoes to their correct definitions.
2. Select from a list uses of a backhoe in highway maintenance.
3. Identify the parts of a typical backhoe.
4. Identify controls on a typical backhoe.
5. State general safety rules for operating equipment.
6. State safety rules for operating backhoes.
7. Select from a list safety and security devices that should be standard equipment on backhoes.
8. Arrange in order steps in a backhoe operating cycle.
9. State suggestions for effective backhoe operation.
10. Complete a safety test on backhoe operation.
11. Demonstrate the ability to
    a. Perform prestart inspection and maintenance procedures on a backhoe.
    b. Service a backhoe.
    c. Start, warm up, operate, and shut down a backhoe.
    d. Carry a straight line while excavating a ditch and loading a haul truck.
    e. Operate a backhoe equipped with a hydraulic breaker.
    f. Dig a trench alongside a building or wall.
    g. Set pipe near overhead utilities.
    h. Dig a trench on unstable soil.

BACKHOES
UNIT V

SUGGESTED ACTIVITIES

I. Suggested activities

   A. Provide students with objective sheet.

   B. Provide students with information, assignment, and job sheets.

   C. Discuss unit and specific objectives.

   D. Discuss information and assignment sheets.

   E. Demonstrate and discuss procedures outlined in job sheets.

   F. Provide alternate jobs if those in job sheets are not practical.

   G. Provide students with operator's manuals and maintenance guides for specific equipment used in job sheets.

   H. Identify backhoe safety devices and how they are used.

   I. Invite resource person to speak on backhoe operation and safety.

   J. Arrange a field trip for students to observe backhoe operation.

   K. Review hand signals

   (NOTE: Hand signal transparencies can be found in Unit XXI, "Rigging.")

   L. Give test.

II. Instructional materials

   A. Objective sheet

   B. Suggested activities

   C. Information sheet

   D. Assignment Sheet #1--Complete a Safety Test on Backhoe Operation

   E. Answers to assignment sheet

   F. Job sheets

      1. Job Sheet #1--Perform Prestart Inspection and Maintenance Procedures on a Backhoe

      2. Job Sheet #2--Service a Backhoe

      3. Job Sheet #3--Start, Warm Up, Operate, and Shut Down a Backhoe

SUGGESTED ACTIVITIES

4. Job Sheet #4--Carry a Straight Line While Excavating a Ditch and Loading a Haul Truck
5. Job Sheet #5--Operate a Backhoe Equipped with a Hydraulic Breaker
6. Job Sheet #6--Dig a Trench Alongside a Building or Wall
7. Job Sheet #7--Set Pipe Near Overhead Utilities
8. Job Sheet #8--Dig a Trench on Unstable Soil

G. Test

H. Answers to test

III. Unit references

A. Nichols, Herbert L., Jr. *Moving the Earth.* 3rd ed. Greenwich, Connecticut: North Castle Books, 1976.

B. *Operating Instructions, 325-H.* South Milwaukee, Wisconsin: Bucyrus-Erie Company Sales Development Department, n.d.

C. *Operators Manual, Loader Backhoe 780-CK.* Racine, Wisconsin: JI Case Company, n.d.

D. *Hydraulic Backhoe-Loader Manual.* Olympia, Washington: State Department of Transportation, 1980.

BACKHOE
UNIT V

INFORMATION SHEET

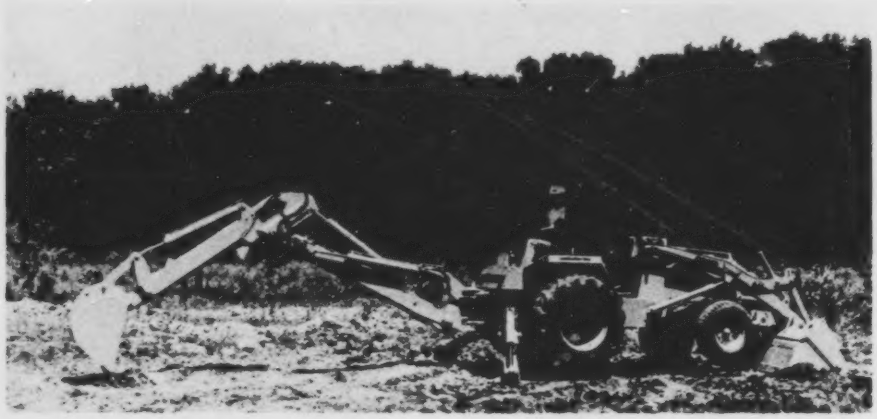
I. Terms and definitions

A. Backhoe--Hydraulically-operated bucket mounted on the rear of a crawler or wheel-type tractor (Figure 1)

(NOTE: A backhoe is frequently equipped with a loader attachment on the front end.)

EXAMPLE:

FIGURE 1



Courtesy of JI Case, a Tenneco Company.

B. Shoring--Temporary bracing to keep sides of excavation from caving in

C. Lockup kit--Metal panels used to protect backhoe from break-ins (vandalism)

D. SMV--Slow-moving vehicle

E. Daylighting requirement--Safety rule requiring that there be enough daylight to perform work effectively

F. Curl--To rotate the bucket

G. Crowd--To force bucket into digging; mechanism that does the forcing

INFORMATION SHEET

H. Spoil--Waste material from digging operation

I. Failure--Collapse, break, or bend in road surface

EXAMPLES: Potholes, cracks, frost heaves

J. Mud pad--Timbers lashed together and used to support machine in unstable soil

II. Uses of a backhoe in highway maintenance

A. Digging ditches

B. Cleaning right-of-way areas

EXAMPLES: Culverts, under bridges

C. Loading trucks

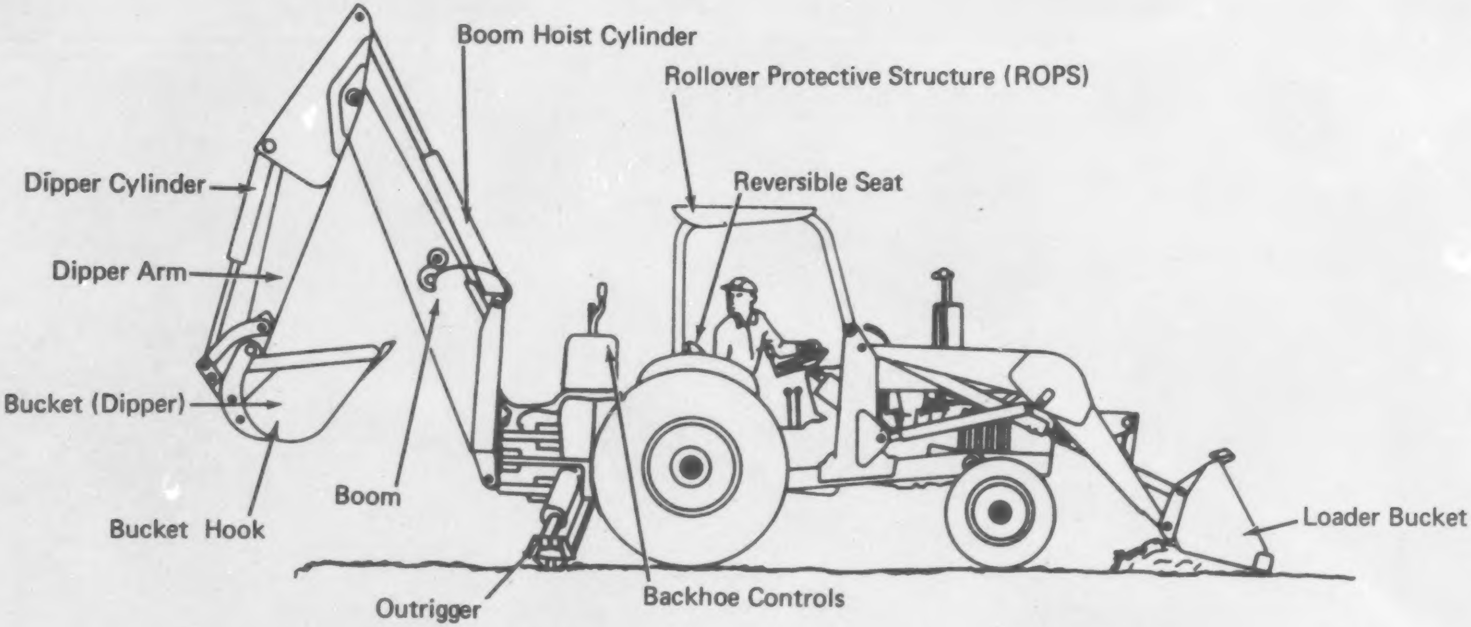
D. Lifting heavy objects

E. Removing asphalt material from road failures

INFORMATION SHEET

III. Parts of a typical backhoe (Figure 2)

FIGURE 2


Boom Hoist Cylinder
Rollover Protective Structure (ROPS)
Dipper Cylinder
Reversible Seat
Dipper Arm
Bucket (Dipper)
Boom
Bucket Hook
Loader Bucket
Outrigger
Backhoe Controls

Used with permission of Deere & Company, Moline, Illinois.

INFORMATION SHEET

IV. Controls on a typical backhoe (Figure 3; Job Sheet #3)

(NOTE: The backhoe has two sets of controls. The tractor controls face the front of the tractor, and the backhoe controls face the backhoe. Tractor controls are not shown in this unit. Controls will vary with model and manufacturer. The illustration below is for a J I Case Loader Backhoe, model 780-CK.)

FIGURE 3

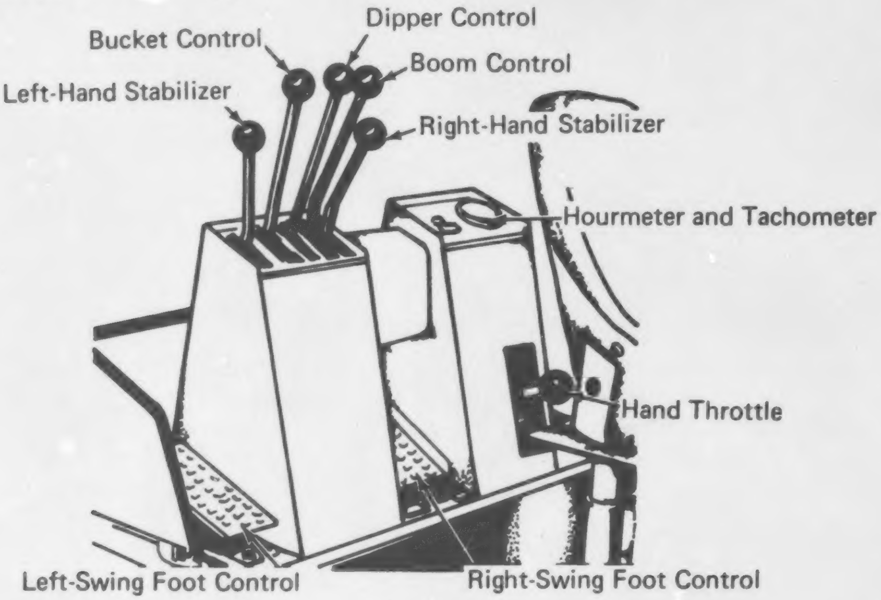

Dipper Control
Bucket Control
Boom Control
Left-Hand Stabilizer
Right-Hand Stabilizer
Hourmeter and Tachometer
Hand Throttle
Left-Swing Foot Control
Right-Swing Foot Control

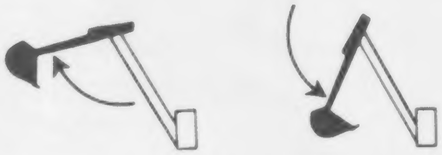
Illustration used with permission of J I Case, a Tenneco Company.

A. Hand throttle--Controls backhoe engine speed

B. Dipper control--Extends and retracts dipper boom (Figure 4)

EXAMPLE:

FIGURE 4



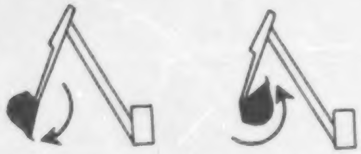
Illustrations used with permission of JI Case, a Tenneco Company.

INFORMATION SHEET

C. Bucket control--Opens and retracts bucket (Figure 5)

EXAMPLE:

FIGURE 5

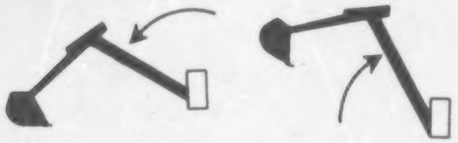


D. Boom control--Lowers and raises boom (Figure 6)

(NOTE: On some models, the boom control lever also moves the boom to the left and right.)

EXAMPLE:

FIGURE 6



Illustrations in Figures 5 and 6 used with permission of JI Case, a Tenneco Company.

E. Left-hand stabilizer--Lowers and raises left outrigger

(NOTE: Left and right are to the operator's left and right with seat swiveled to face backhoe.)

F. Right-hand stabilizer--Lowers and raises right outrigger

G. Left-swing foot control--Controls boom swing to left

H. Right-swing foot control--Controls boom swing to right

(NOTE: On some models, the boom control lever controls left and right swing.)

I. Hourmeter--Indicates total hours and tenths of hours engine has operated

J. Tachometer--Indicates engine speed in revolutions per minute (rpm)

(NOTE: Some models are equipped with a swing brake that automatically slows the boom before it hits the stops on the main frame.)

INFORMATION SHEET

V. General safety rules for operating equipment (Assignment Sheet #1)

  A. Read operator's manual thoroughly: know your machine

  B. Wear safety items required by job conditions

  EXAMPLES: Close-fitting clothing, hard hat, ear protection, eye protection

  C. Know and observe hand signals

  D. Be sure all safety guards and covers are in place and secure

  E. Do not operate machine until you are sure that all personnel and obstructions are cleared from area

  F. Check all safety devices before moving machine

  G. Do not jump on or off machine

  H. Mount and dismount properly, using handholds and steps

  I. Do not allow anyone to ride on machine

  J. Know traffic pattern of job and obey spotter

  K. Always park on level ground when possible

  L. Do not leave engine running unattended

  M. Avoid operating too close to banks or overhangs

  N. Watch for overhead electrical power lines

  (NOTE: Equipment does not have to come in direct contact with wires to act as a conductor. If operating near power lines, power to lines should be shut off, or lines should be insulated.)

  (CAUTION: Do not operate within 10 feet of power lines.)

  O. Watch for flags indicating buried power lines, gas lines, and pipes

  (NOTE: Telephone and utility companies will flag the work site with appropriately colored flags: Gas and chemicals, *yellow*; phone, *orange*: electric, *red*; water, *blue*; sanitary and storm sewers, *green*.)

VI. Safety rules for operating backhoes (Assignment Sheet #1)

  (NOTE: A careful operator is always the best insurance against an accident.)

  A. Do not permit anyone to stand alongside trench being excavated

  B. Check all component hinge pins and their securing devices often

INFORMATION SHEET

C. Be sure outriggers are properly extended before starting operations

(NOTE: Outriggers should lift wheels off the ground to stabilize backhoe.)

D. If trench excavation is to be more than 4 feet deep, do not excavate unless all shoring and daylighting requirements are met

E. Observe extreme caution when operating under low overhead obstructions

F. Observe extreme caution when excavating near underground wires and pipes

G. Always use warning signs and traffic control procedures when working on roads or streets

H. Never perform service or repairs on equipment that has not been properly blocked, secured, and tagged

I. Keep bucket as close to ground as possible when transporting loads

J. When operating on a steep slope, carry boom on uphill side for added stability

K. Always travel at safe operating speed

VII. Safety and security devices that should be standard equipment on backhoes

A. Horn

B. Backup lights

C. Backup alarm

D. Roll over protective structure (ROPS)

E. Slow-moving vehicle (SMV) emblem

F. Lockup kit

G. Spark-arresting muffler

H. Brake air reservoir warning buzzer

I. Forward/reverse safety lock

J. Stoplights, taillights, and flasher lights

VIII. Steps in a backhoe operating cycle (Job Sheets #4-#8)

A. Filling bucket during digging motion

B. Dragging

INFORMATION SHEET

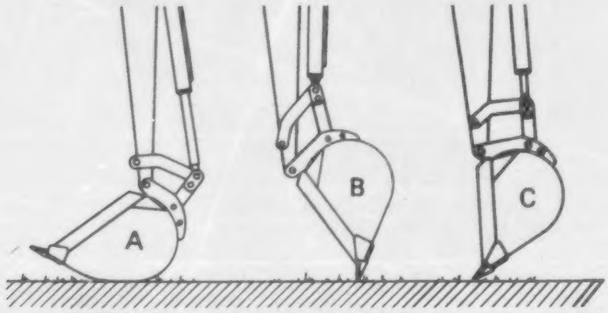
- C. Hoisting
- D. Swinging
- E. Dumping
- F. Returning to digging position

IX. Suggestions for effective backhoe operation (Job Sheet #1)

- A. Perform prestart inspection and maintenance procedures
- B. Set up as short a work cycle as possible
- C. Keep transport distances as short as possible
- D. Carry bucket just high enough to clear obstacles when transporting load
- E. Start raising boom so that bucket reaches dumping height at dump area
- F. Fill truck gradually from far side to near side
- G. Work from top down, filling bucket with shallow bites
- H. Always dig with bucket in correct position (Figure 7)

EXAMPLE:

FIGURE 7



A. INCORRECT-- Bucket too far forward

B. INCORRECT-- Bucket too far back

C. CORRECT

Used with permission of Deere & Company, Moline, Illinois.

- I. When dumping bucket, actuate crowd and bucket cylinders at the same time to be ready for return cycle
- J. Pick up bucket when it is full

INFORMATION SHEET

K. When loading trucks, curl bucket close to dipper arm to prevent spilling

L. Keep machine clean

M. Service machine regularly

N. Keep radiator free of bugs and trash, particularly during hot weather

BACKHOE
UNIT V

ASSIGNMENT SHEET #1--COMPLETE A SAFETY TEST ON BACKHOE OPERATION

NAME ______________________________ SCORE ______________

Accident prevention is one of the operator's first concerns. An operator must learn and follow safety rules in order to avoid personal injury, avoid injury to others, protect property and equipment, and minimize downtime.

Complete the following test on safety rules for equipment and backhoe operation. You may refer to Sections V and VI in your Information Sheet.

PART I

Complete the following safety rules. Write the correct word or words in the blanks.

A. Avoid operating too close to ______________ or ______________.

B. Check all ______________ ______________ before moving machine.

C. Do not leave engine ______________ ______________.

D. Never perform ____________ or ____________ on equipment that has not been properly ____________, ______________, and ____________.

E. Check all component ______________ ______________ and their ______________ ______________ often.

F. Always park on ______________ ______________ when possible.

G. Watch for ______________ indicating buried ________ ________, ______________ ______________, and ____________.

H. Be sure all ____________ ______________ and ____________ are in place and secure.

I. Observe extreme caution when operating under ____________ ____________ ____________.

ASSIGNMENT SHEET #1

J. Keep bucket ______________ ______________ ______________

______________ ______________ ______________ when transporting loads.

K. Watch for overhead ______________ ______________ ______________.

L. Wear ______________ ______________ required by job conditions.

PART II

Write safety rules pertaining to the following procedures.

A. Working on roads or streets: ______________________________

____

B. Operating on a steep slope: ______________________________

____

C. Excavating

1. ______________________________

____

2. ______________________________

____

3. ______________________________

____

D. Personnel: ______________________________

____

E. Extending outriggers: ______________________________

____

F. Traffic: ______________________________

____

G. Hand signals: ______________________________

____

ASSIGNMENT SHEET #1

H. Mounting and dismounting machine:

1. ____________________

2. ____________________

I. Passengers: ____________________

BACKHOE
UNIT V

ANSWERS TO ASSIGNMENT SHEET

PART I

A. banks, overhangs

B. safety devices

C. running unattended

D. service, repairs, blocked, secured, tagged

E. hinge pins, securing devices

F. level ground

G. flags, power lines, gas lines, pipes

H. safety guards, covers

I. low overhead obstructions

J. as close to ground as possible

K. electrical power lines

L. safety items

PART II

A. Always use warning signs and proper control procedures when working on roads or streets

B. Carry boom on uphill side for added stability

C.
  1. If trench excavation is to be more than 4 feet deep, do not excavate unless all shoring and daylighting requirements are met
  2. Observe extreme caution when excavating near underground wires and pipes
  3. Do not permit anyone to stand alongside trench being excavated

D. Do not operate machine until you are sure that all personnel and obstructions are cleared from area

E. Be sure outriggers are properly extended before starting operations

F. Know traffic pattern of job and obey spotter

ANSWERS TO ASSIGNMENT SHEET

G. Know and observe hand signals

H. 1. Do not jump on or off machine

  2. Mount and dismount properly, using handholds and steps

I. Do not allow anyone to ride on machine

BACKHOE
UNIT V

JOB SHEET #1--PERFORM PRESTART INSPECTION AND MAINTENANCE PROCEDURES ON A BACKHOE

I. Equipment and materials

   A. Backhoe

   B. Operator's manual

   C. Engine oil

   D. Engine coolant

   E. Hydraulic fluid

   F. Fuel

   G. Lubricants

   H. Grease gun

   I. Rags

II. Procedures

   (NOTE: Deficiencies should be corrected immediately or reported to the proper authority. Do not operate defective equipment.)

   A. Make a walk-around visual inspection for leaks and broken, worn, or missing parts

   B. Check engine oil level; add oil if needed

   C. Check engine coolant level; add coolant if needed

   D. Check hydraulic reservoir level; add fluid if needed

   E. Check fuel level; fill tank if necessary

   F. Check battery connections for tightness and corrosion

   G. Check battery electrolyte level; add water if needed

   H. Check air cleaner; remove and clean filter if necessary

   I. Check brakes

   J. Check tires

JOB SHEET #1

K. Clean all grease fittings and lubricate according to operator's manual

L. Check hydraulic system for leaking lines and connections, bent or kinked lines, and lines rubbing against other parts

M. Check drive belts for tightness

N. Check electrical wire connections and insulation

O. Clean windshield and mirrors; adjust mirrors

P. Check gauges

Q. Check foot pedals for proper functioning

R. Check levers and controls for proper functioning

S. Remove trash

T. Check lights

U. Check safety devices

V. Check major components

1. Loader bucket
2. Backhoe bucket
3. Backhoe boom
4. Backhoe dipperstick
5. Cylinders
6. Hinge pins and their securing devices

BACKHOE
UNIT V

JOB SHEET #2--SERVICE A BACKHOE

I. Equipment and materials

- A. Backhoe
- B. Operator's manual
- C. Tool kit
- D. Air supply
- E. Grease gun
- F. Lubricants
- G. Cleaning solvents
- H. Rags
- I. Water
- J. Engine coolant
- K. Engine oil
- L. Hydraulic fluid
- M. Transmission fluid
- N. Brake fluid
- O. Tire pressure gauge
- P. Fuel

II. Procedure

(NOTE: Follow departmental preventive maintenance program when servicing equipment. Refer to operator's manual for lubrication chart and for servicing specific components and attachments.)

A. Visually inspect for leaks and broken, worn, or missing parts

(NOTE: Major repairs and replacements should be reported to the proper authority and completed by a trained mechanic.)

B. Check engine oil level, filter, lines and hoses; add engine oil if needed

JOB SHEET #2

C. Check engine coolant level, radiator cap, hose, and radiator; add coolant if necessary

(CAUTION: Do not remove radiator cap unless engine is cool; then, open cap slowly to release pressure.)

D. Clean air filters; replace if necessary

E. Check fuel level, fuel filters, and sediment bowl (where applicable); fill fuel tank if necessary

F. Check battery electrolyte level, battery cables, and connectors; add water or electrolyte if needed

(CAUTION: Keep sparks and fire away from battery.)

G. Check exhaust system for loose connections and holes

H. Check hydraulic fluid level, filters, hoses, lines, and fittings; look for leaks; add fluid if needed

I. Check transmission fluid level; add fluid if needed

J. Check transmission pressure-line filter and breather

K. Check brake adjustment and condition; adjust if necessary

L. Check brake master cylinder fluid level, fill with brake fluid if necessary

M. Check clutch adjustment; adjust if necessary

N. Check drive belts for tension and wear; adjust or replace if necessary

O. Check wiring, insulation, and connections

P. Clean and lubricate grease fittings according to operator's manual

Q. Check tire pressure; inflate tires to recommended pressure if necessary

R. Check condition of tires

S. Check all safety devices; repair if necessary

T. Check major components and/or accessories

   1. Loader bucket
   2. Backhoe bucket, boom, dipper, and cylinders
   3. All hinge pins and securing devices

BACKHOE
UNIT V

JOB SHEET #3--START, WARM UP, OPERATE, AND SHUT DOWN A BACKHOE

I. Equipment and materials

   A. Backhoe

   B. Operator's manual

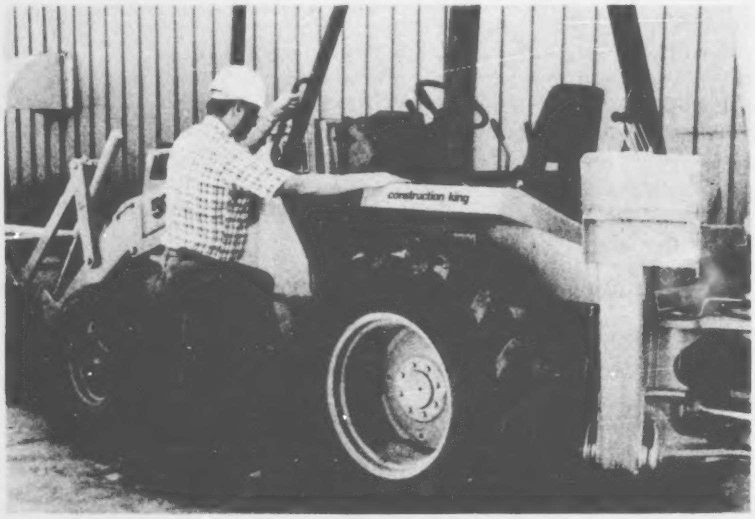
II. Procedure

   A. Read operator's manual for procedures and controls for your backhoe

   B. Perform inspection, daily maintenance, and safety checks

   C. Mount backhoe properly, using handrails and steps (Figure 8)

FIGURE 8



Courtesy of JI Case, a Tenneco Company.

   D. Adjust seat and fasten seat belt

   E. Check to see that all controls are in OFF or NEUTRAL positions

   F. Check parking brake to be sure that it is set

   G. Engage clutch

   H. Set throttle one-quarter to one-third open

   (NOTE: In cold weather, use cold-weather starting aids. See operator's manual.)

JOB SHEET #3

I. Turn ignition key to ON, if machine is so equipped

J. Engage starter

(NOTE: Do not operate starter for more than twenty seconds. If engine fails to start, wait two minutes for starter to cool before re-engaging.)

K. When engine starts, release clutch

L. Allow engine to warm up for five minutes

M. Check to see that all gauges are operating correctly

N. Activate controls to warm up hydraulic fluid

O. Engage clutch

P. Select proper gear

Q. Release parking brake

R. Disengage clutch

S. Move forward

T. Stop backhoe by depressing brake pedal(s) and shifting range-direction lever into neutral

U. Operate through all forward and reverse gears and turns

(NOTE: On some backhoes, reverse speeds are faster than forward speeds. Use caution when operating backhoe in reverse.)

V. Make tight turns using individual brake pedals

   1. Turn left by depressing left brake pedal

   2. Turn right by depressing right brake pedal

W. Depress brake pedal, shift range-direction lever to neutral, and set brake

X. Manipulate controls to raise and lower boom

Y. Manipulate controls to swing boom left and right

Z. Manipulate controls to extend and retract bucket

AA. Manipulate controls to crowd and curl bucket

BB. Manipulate controls to extend, set, and retract outriggers

CC. Practice coordinating movement and controls

JOB SHEET #3

DD. Stop backhoe, shift range-direction lever to neutral, and set parking brake

EE. Lower loader bucket to ground

FF. Run engine at idle with no load for two to three minutes

(NOTE: Running engine at idle permits the engine to cool down and allows for gradual and uniform cooling of engine parts.)

GG. Close throttle

HH. Shut off starter switch

II. Turn key, if machine is so equipped, to OFF position and remove from ignition

JJ. Secure machine according to instructions in operator's manual

KK. Make a visual walk-around check for leaks and broken, worn, or missing parts

BACKHOE
UNIT V

JOB SHEET #4--CARRY A STRAIGHT LINE WHILE EXCAVATING A DITCH AND LOADING A HAUL TRUCK

I. Equipment and materials

  A. Backhoe

  B. Haul truck

II. Procedure

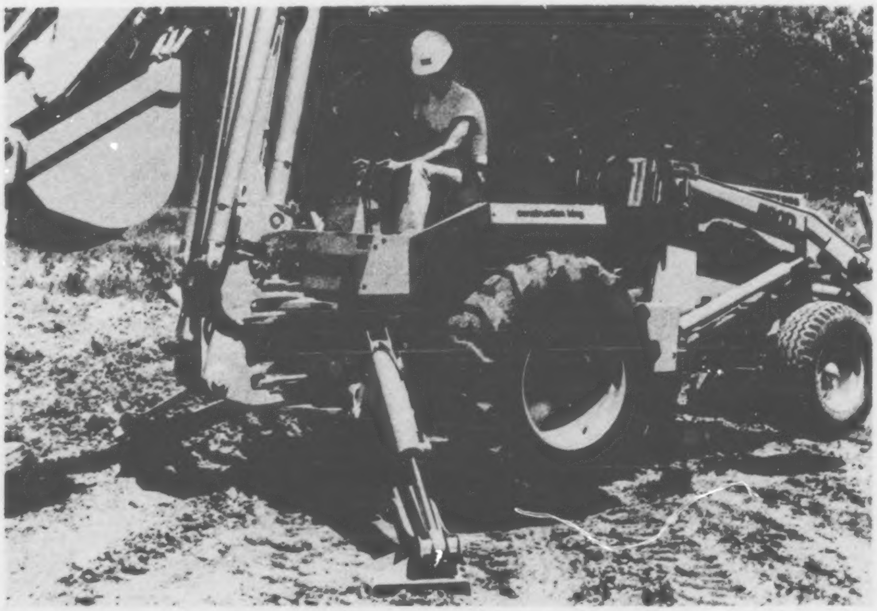
  A. Position backhoe in a straight line with marked lines of proposed ditch

  (NOTE: Lines are usually marked with lime.)

  B. Position truck so that it can be loaded over the side

  C. Lower stabilizers until wheels are off the ground (Figure 9)

FIGURE 9



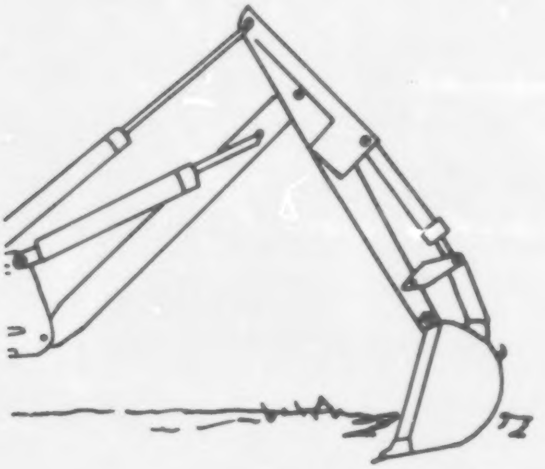
Courtesy of JI Case, a Tenneco Company.

  D. Turn loader bucket over and lower to ground to provide a front stabilizer

JOB SHEET #4

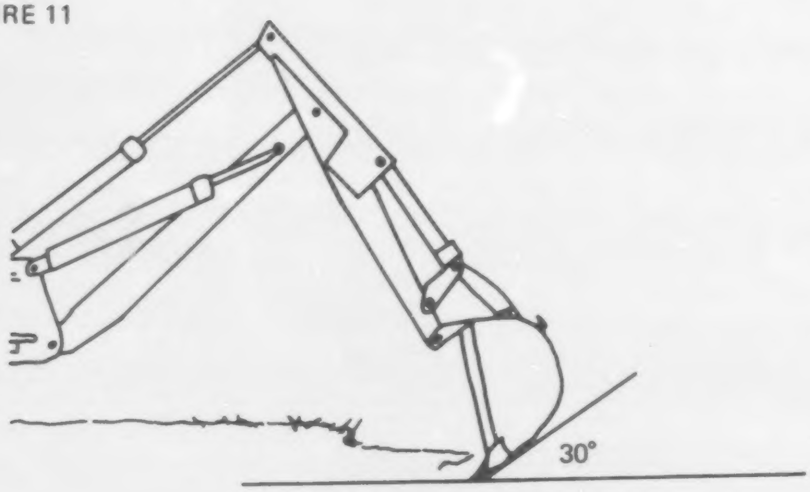
E. Engage bucket arm control to move bucket to 5:30 position (Figure 10)

FIGURE 10



F. Engage bucket control to position cutting edge at approximately a 30-degree angle to ground (Figure 11)

FIGURE 11



G. Move boom control to lower bucket to ground

H. Pull bucket arm control in; as bucket enters material, operate bucket cylinder control so that cutting edge works parallel to ground

(NOTE: Forcing equipment reduces efficiency and durability.)

JOB SHEET #4

I. Load bucket quickly and easily with thin slices

J. If bucket arm slows or stops filling bucket, raise or lower boom control slightly

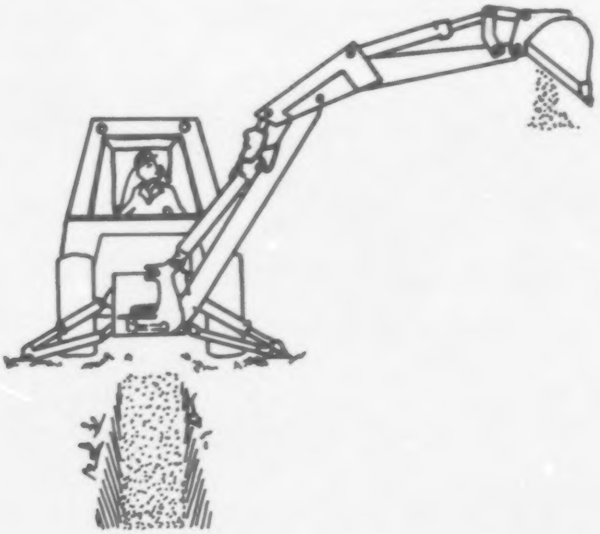
K. Pick up bucket as soon as it is full

(NOTE: As depth of ditch is reached, move backhoe, keeping in line with marked ditch line.)

L. Raise boom control to clear cut and side of truck (Figure 12)

(NOTE: Gradually spilling the load eases the strain on the truck.)

FIGURE 12



(NOTE: Keep bucket arm at six o'clock.)

M. Swing bucket to truck and *gradually* spill load

N. Actuate bucket and bucket arm control levers at the same time for a fast, controlled dump

(NOTE: Load truck from far side to near side.)

O. Swing bucket back to cut and continue cycle until ditch is complete or until truck is loaded

(NOTE: While waiting for truck, use the time to move backhoe or make adjustments, to loosen material, or to clean corners of cut.)

BACKHOE
UNIT V

JOB SHEET #5--OPERATE A BACKHOE EQUIPPED WITH A HYDRAULIC BREAKER

I. Equipment and materials

   A. Backhoe

   B. Hydraulic concrete breaker attachment

II. Procedure

   A. Mount backhoe and start engine

   B. Raise outriggers (stabilizers)

   C. Raise loader bucket

   D. Raise breaker attachment

   E. Proceed to job location

   F. Move to starting point and set up machine

   G. Lower loader bucket to ground enough to take pressure off front tires

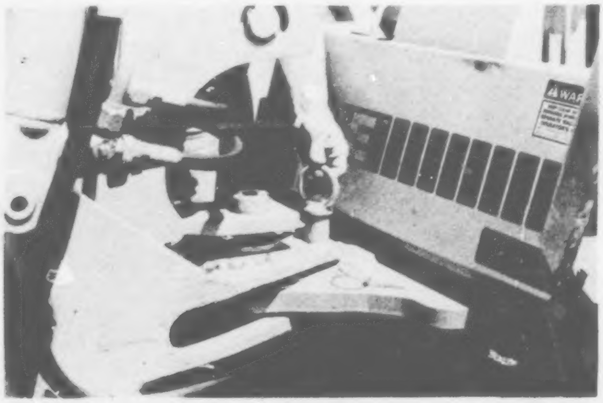
   H. Move to backhoe controls

   I. Lower outriggers to ground until backhoe is level and most of rear weight of backhoe is on outriggers

   J. Lower breaker to ground

   K. Remove swing lock pin and boom lock pin if so equipped (Figure 13)

FIGURE 13



Courtesy of JI Case, a Tenneco Company.

JOB SHEET #5

L. Position breaker to start breaking concrete

M. Use foot control to engage hammer

N. Start breaking, and continue until area within reach of breaker is completely broken

O. Move machine

P. Raise breaker attachment

Q. Raise outriggers

R. Raise loader bucket

(NOTE: When all of the area within reach of the backhoe is broken, the backhoe will have to be moved back so that the breaker can just reach the section already broken.)

S. Continue breaking operations until job is completed

BACKHOE
UNIT V

JOB SHEET #6--DIG A TRENCH ALONGSIDE A BUILDING OR WALL

I. Equipment--Backhoe

II. Procedure

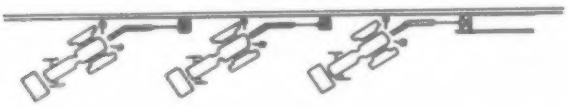
A. Road backhoe to job site

B. Place warning signs if needed

C. Back unit toward building or wall at an angle until swing post is over center of trench

D. Turn front wheels parallel to trench (Figure 14)

FIGURE 14



Used with permission of International Harvester Company.

E. Extend outriggers to stabilize backhoe

F. Start digging, casting material away from building or wall

(NOTE: Cast material far enough away to allow working room alongside trench.)

G. Dig as much of trench as is practical before moving backhoe

H. Retract outriggers

I. Reposition backhoe as in steps C, D, and E so that bucket will reach end of previous cut

J. Continue this procedure until trench is completed

K. Retract outriggers, and move backhoe a few paces from trench

L. Prepare backhoe for transporting

M. Move to next job or return to base

N. Shut down and dismount properly if returned to base

BACKHOE
UNIT V

JOB SHEET #7--SET PIPE NEAR OVERHEAD UTILITIES

I. Equipment, materials, and personnel

  A. Backhoe

  B. Pipe hook, or sling with sliding choker hook

  (NOTE: Some operators prefer to use a sling rather than a pipe hook, especially when working in a trench box.)

  C. Sections of pipe

  D. Warning signs

  E. Spotter

II. Procedure

(NOTE: Equipment does not have to come in direct contact with wires to act as a conductor. If operating near power lines, power to lines should be shut off, or lines should be insulated.)

(CAUTION: Do not operate within 10 feet of power lines.)

  A. Place warning signs

  B. Check height and location of overhead utilities relative to work area

  C. Check location and color of underground survey flags if present

  D. Fill bucket with subgrade material

  (NOTE: After excavation of ditch, it is necessary to place subgrade material in bottom of ditch.)

  E. Cast out bucket to spread material

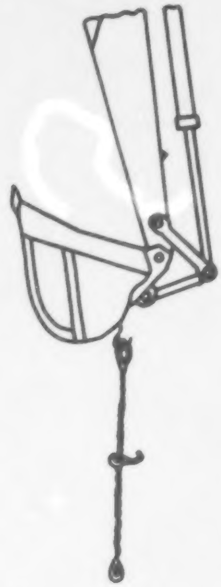
  F. Drag bucket (teeth down) through ditch to help level material and maintain grade

JOB SHEET #7

G. Curl bucket until hook is in position to attach sling

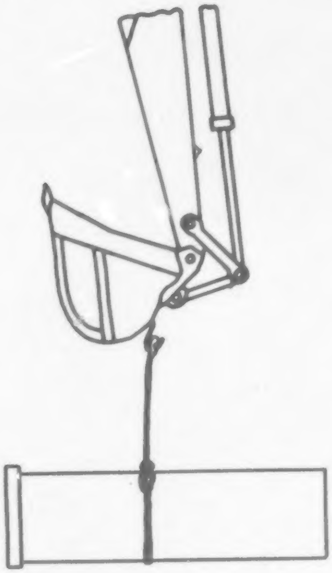
(NOTE: Spotter will connect sling to bucket hook [Figure 15]; pipe will be brought from stockpile to ditch location by other equipment. This will eliminate moving the backhoe in and out of ditch.)

FIGURE 15



H. Lower boom, and center over pipe section so that sling can be attached by spotter (Figure 16)

FIGURE 16



JOB SHEET #7

I. Raise boom until slack is taken out of sling

(NOTE: When pipe is in sections, a whip or tagline should be attached to one end of the pipe so that spotter can control pipe and keep it from swinging and damaging equipment or property.)

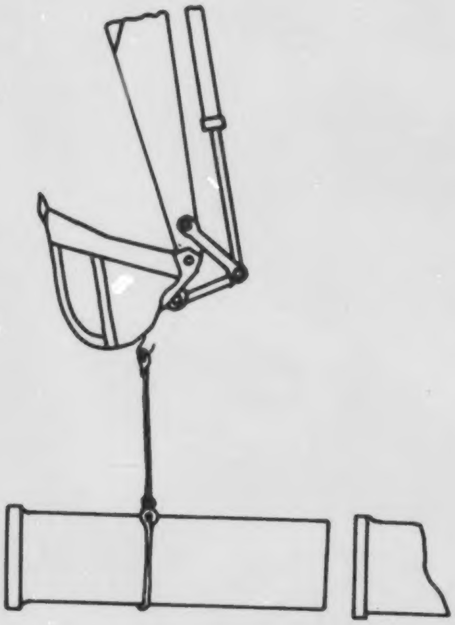
J. Continue raising boom until pipe section clears all obstructions

(CAUTION: When working around power lines, maintain a safe distance at all times.)

K. Lower pipe section *slowly* so that it lies at end of pipe already set (Figure 17)

(NOTE: Ground crew will help line up pipes and make connections.)

FIGURE 17



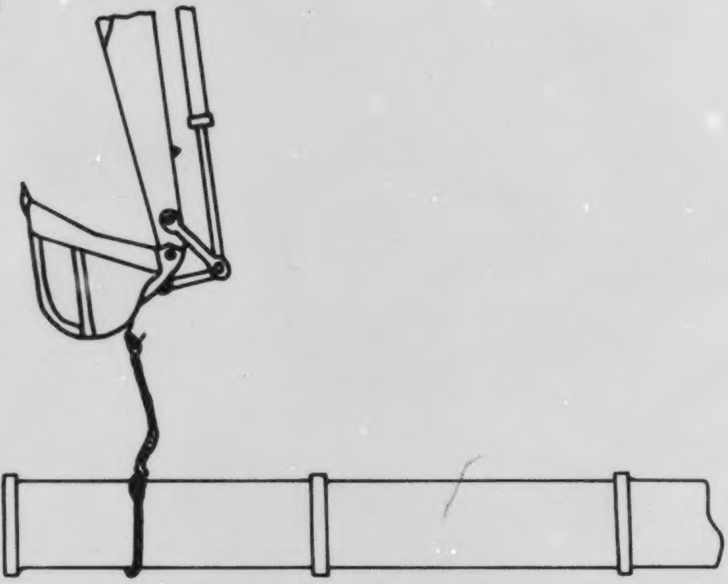
JOB SHEET #7

L. Move bucket control to roll bucket out and position pipe section

M. Lower boom slightly to put slack in sling (Figure 18)

(NOTE: Spotter will disconnect sling.)

FIGURE 18



N. Reposition backhoe to set next section of pipe

O. Continue cycle until job is completed

BACKHOE
UNIT V

JOB SHEET #8--DIG A TRENCH ON UNSTABLE SOIL

I. Equipment, materials, and personnel

A. Backhoe

B. Two 36" x 48" x 4" mats with attached lifting cables

C. Small flatbed truck

D. Truck operator

E. Chain or sling

(NOTE: If loader bucket has a toothed edge, chain or sling is not necessary.)

II. Procedure

A. Loop lifting cables on mats over tooth on loader bucket edge

(NOTE: If bucket edge is not toothed, loop chain or sling over bucket hook onto lifting cables.)

B. Load mats on flatbed truck

C. Proceed to job site with backhoe

(NOTE: Truck will also proceed to job site. Truck driver should position truck as near actual work area as possible.)

D. Lift mats from truck with loader bucket

E. Place one on each side of trench site so that outrigger pads can rest on mats

F. Move backhoe into digging position

G. Lower outriggers until outrigger pads rest on mats

H. Apply pressure on outriggers until backhoe is level and stable

I. Dig as much of trench as backhoe will reach

J. Cast spoil far enough to side to leave working room along trench

K. Continue digging, moving mats as necessary

L. Complete trenching operation

M. Retract outriggers

JOB SHEET #8

N. Loop lifting cables on mats over tooth on loader bucket edge

(NOTE: If bucket edge is not toothed, loop chain or sling over bucket hook onto lifting cables.)

O. Load mats onto truck

P. Move to next job or return to base

Q. If returned to base, shut down backhoe and dismount properly

BACKHOE
UNIT V

TEST

NAME ______________________________ SCORE ______________

1. Match terms associated with backhoes to their correct definitions. Write the correct numbers in the blanks.

______a. Temporary bracing to keep sides of excavation from caving in

______b. Metal panels used to protect backhoe from break-ins (vandalism)

______c. Slow-moving vehicle

______d. To rotate the bucket

______e. To force bucket into digging; mechanism that does the forcing

______f. Timbers lashed together and used to support machine in unstable soil

______g. Waste material from digging operation

______h. Hydraulically-operated bucket mounted on the rear of a crawler or wheel-type tractor

______i. Collapse, break, or bend in road surface

______j. Safety rule requiring that there be enough daylight to perform work effectively

1. Curl
2. Mud pad
3. Daylighting requirement
4. Lockup kit
5. Crowd
6. Failure
7. Shoring
8. SMV
9. Spoil
10. Backhoe

2. Select from the following list uses of a backhoe in highway maintenance. Write an "X" in the blank before each correct answer.

______a. Loading trucks

______b. Towing

______c. Digging ditches

______d. Cleaning right-of-way areas

______e. Lifting personnel

______f. Lifting heavy objects

______g. Loading equipment

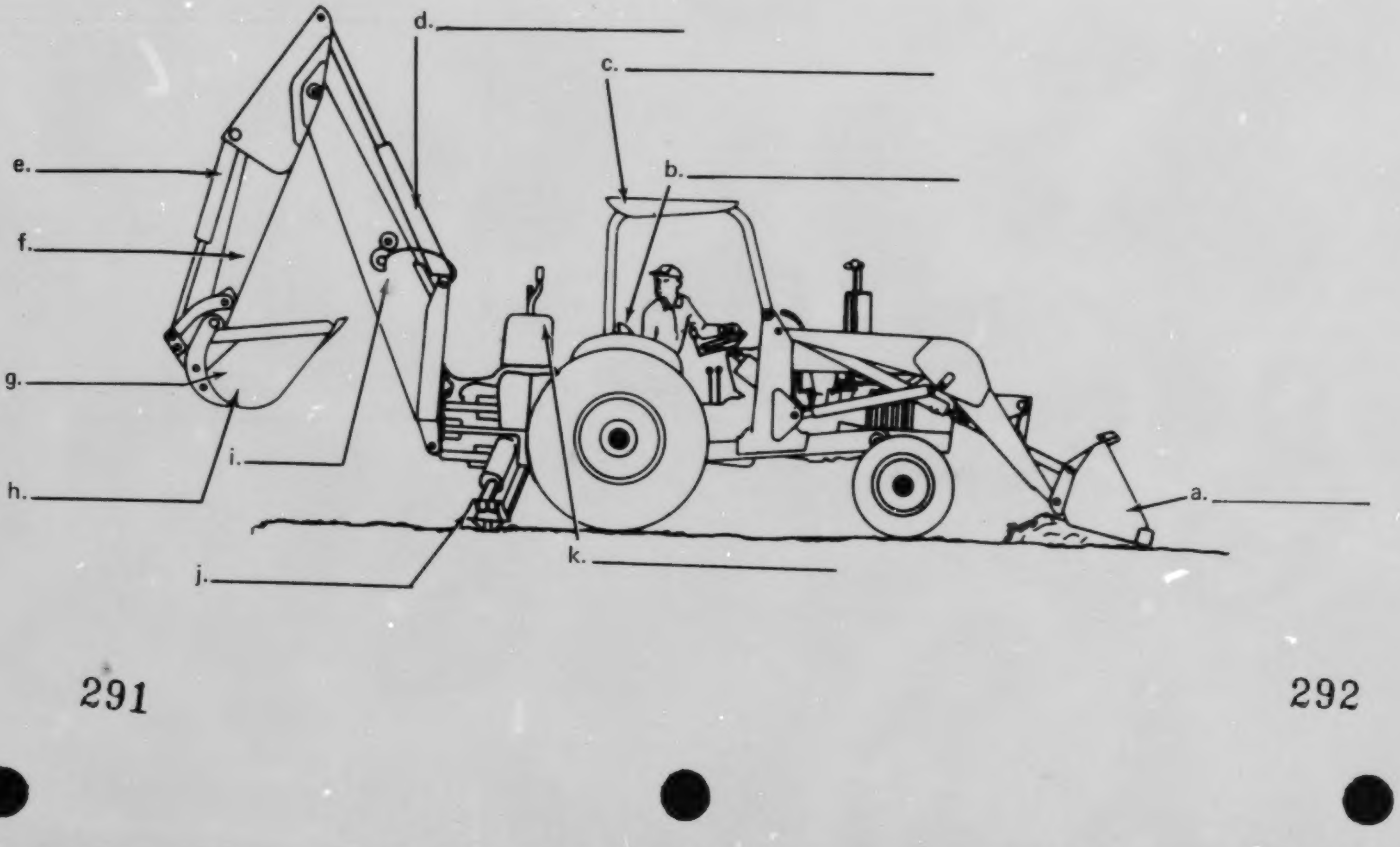
______h. Removing asphalt material from road failures

______i. Finish grading

TEST

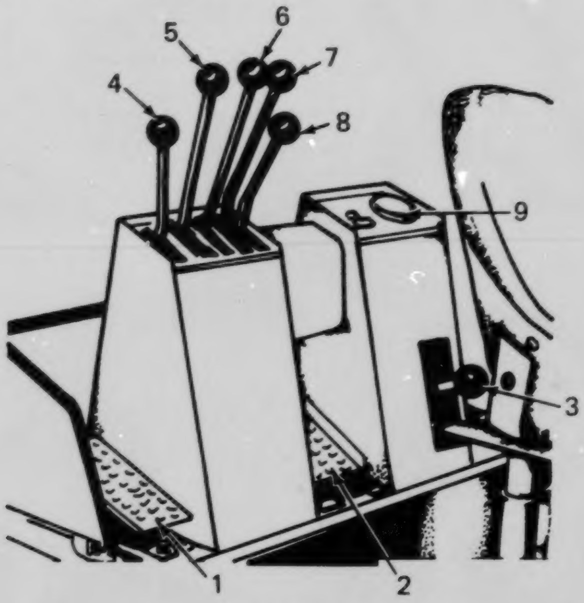
3. Identify the parts of a typical backhoe. Write the correct names in the blanks.

Loader bucket
Bucket
Dipper arm
Controls
Reversible seat
Bucket hook
Outriggers
Dipper cylinder
Roll over protective structure (ROPS)
Boom hoist cylinder
Boom



TEST

4. Identify controls on a typical backhoe. Write the correct numbers in the blanks. Some answers may be used more than once.



_____a. Right-swing foot control--Controls boom swing to right

_____b. Bucket control--Opens and retracts bucket

_____c. Hand throttle--Controls backhoe engine speed

_____d. Left-swing foot control--Controls boom swing to left

_____e. Dipper control--Extends and retracts dipper boom

_____f. Hourmeter--Indicates total hours and tenths of hours engine has operated

_____g. Left-hand stabilizer--Lowers and raises left outrigger

_____h. Tachometer--Indicates engine speed in revolutions per minute (rpm)

_____i. Boom control--Lowers and raises boom

_____j. Right-hand stabilizer--Lowers and raises right outrigger

5. State six general safety rules for operating equipment.

a. ____

b. ____

TEST

c. ____

d. ____

e. ____

f. ____

6. State six safety rules for operating backhoes.

a. ____

b. ____

c. ____

d. ____

e. ____

f. ____

7. Select from the following list safety and security devices that should be standard equipment on backhoes. Write an "X" in the blank before each correct answer.

_____a. Spark-arresting muffler

_____b. Roll over protective structure (ROPS)

_____c. Department of Transportation emblem

_____d. Cab overhead light

_____e. Horn

_____f. Wheel weights

_____g. Backup lights

_____h. Lockup kit

_____i. Brake air reservoir warning buzzer

_____j. Boom safety lock

_____k. Stoplights, taillights, and flasher lights

_____l. Tire chains

TEST

_____m. Backup alarm

_____n. Slow-moving vehicle (SMV) emblem

_____o. Forward/reverse safety lock

8. Arrange in order steps in a backhoe operating cycle. Write a "1" before the first step, a "2" before the second step, and so on.

_____a. Dumping

_____b. Dragging

_____c. Returning to digging position

_____d. Hoisting

_____e. Filling bucket during digging motion

_____f. Swinging

9. State eight suggestions for effective backhoe operations.

a. ______________________________

b. ______________________________

c. ______________________________

d. ______________________________

e. ______________________________

f. ______________________________

g. ______________________________

h. ______________________________

(NOTE: Test questions 10 and 11 list the assignment and job sheets. They are an important part of this test. If they have not been completed, check with your instructor.)

10. Complete a safety test on backhoe operation.

11. Demonstrate the ability to:

    a. Perform prestart inspection and maintenance procedures on a backhoe.

    b. Service a backhoe.

    c. Start, warm up, operate, and shut down a backhoe.

TEST

d. Carry a straight line while excavating a ditch and loading a haul truck.

e. Operate a backhoe equipped with a hydraulic breaker.

f. Dig a trench alongside a building or wall.

g. Set pipe near overhead utilities.

h. Dig a trench on unstable soil.

BACKHOE
UNIT V

ANSWERS TO TEST

1. a. 7
   b. 4
   c. 8
   d. 1
   e. 5
   f. 2
   g. 9
   h. 10
   i. 6
   j. 3

2. a, c, d, f, h

3. a. Loader bucket
   b. Reversible seat
   c. Roll over protective structure (ROPS)
   d. Boom hoist cylinder
   e. Dipper cylinder
   f. Dipper arm
   g. Bucket (dipper)
   h. Bucket hook
   i. Boom
   j. Outrigger controls
   k. Backhoe controls

4. a. 2
   b. 5
   c. 3
   d. 1
   e. 6
   f. 9
   g. 4
   h. 9
   i. 7
   j. 8

5. Answer should include any six of the following
   a. Read operator's manual thoroughly: know your machine
   b. Wear safety items required by job conditions
   c. Know and observe hand signals
   d. Be sure all safety guards and covers are in place and secure
   e. Do not operate machine until you are sure that all personnel and obstructions are cleared from area
   f. Check all safety devices before moving machine

ANSWERS TO TEST

g. Do not jump on or off machine

h. Mount and dismount properly, using handholds and steps

i. Do not allow anyone to ride on machine

j. Know traffic pattern of job and obey spotter

k. Always park on level ground when possible

l. Do not leave engine running unattended

m. Avoid operating too close to banks or overhangs

n. Watch for overhead electrical power lines

o. Watch for flags indicating buried power lines, gas lines, and pipes

6. Answer should include any six of the following

a. Do not permit anyone to stand alongside trench being excavated

b. Check all component hinge pins and their securing devices often

c. Be sure outriggers are properly extended before starting operations

d. If trench excavation is to be more than 4 feet deep, do not excavate unless all shoring and daylighting requirements are met

e. Observe extreme caution when operating under low overhead obstructions

f. Observe extreme caution when excavating near underground wires and pipes

g. Always use warning signs and traffic control procedures when working on roads or streets

h. Never perform service or repairs on equipment that has not been properly blocked, secured, and tagged

i. Keep bucket as close to ground as possible when transporting loads

j. When operating on a steep slope, carry boom on uphill side for added stability

k. Always travel at safe operating speed

7. a, b, e, g, h, i, k, m, n, o

8.

a.	5	d.	3
b.	2	e.	1
c.	6	f.	4

ANSWERS TO TEST

9. Answer should include any eight of the following
   - a. Perform prestart inspection and maintenance procedures
   - b. Set up as short a work cycle as possible
   - c. Keep transport distances as short as possible
   - d. Carry bucket just high enough to clear obstacles when transporting load
   - e. Start raising boom so that bucket reaches dumping height at dump area
   - f. Fill truck gradually from far side to near side
   - g. Work from top down, filling bucket with shallow bites
   - h. When dumping bucket, actuate crowd and bucket cylinders at the same time to be ready for return cycle
   - i. Always dig with bucket in correct position
   - j. Pick up bucket when it is full
   - k. When loading trucks, curl bucket close to dipper arm to prevent spilling
   - l. Keep machine clean
   - m. Service machine regularly
   - n. Keep radiator free of bugs and trash, particularly during hot weather
10. Evaluated to the satisfaction of the instructor
11. Performance skills evaluated to the satisfaction of the instructor

CRANES AND ATTACHMENTS
UNIT VI

UNIT OBJECTIVE

After completing this unit, the student should be able to set up and operate a cable crane using different types of attachments. This knowledge will be shown by completing job sheets and unit test with a minimum score of 85 percent.

SPECIFIC OBJECTIVES

After completing this unit, the student should be able to

1. Match terms associated with cranes and attachments to their correct definitions.
2. Label crane accessories and/or attachments used in highway maintenance.
3. Identify parts of a truck cable crane.
4. Match cab controls on a typical crane to their correct functions.
5. State general safety rules for operating heavy equipment.
6. State safety factors for setting up a crane.
7. Select from a list equipment-handling hazards or conditions that lead to hazards.
8. Select from a list information the operator needs to determine equipment capabilities.
9. Select from a list procedures for effective crane operation.
10. Arrange in order procedures for hoisting a load.
11. State principles of hoisting.
12. Identify parts of a typical dragline system.
13. Select from a list procedures for effective dragline operation.
14. Identify parts of a typical clamshell system.
15. Select from a list procedures for effective clamshell operation.
16. Demonstrate the ability to
    a. Perform prestart inspection and maintenance procedures on a truck-mounted cable crane.
    b. Service a crane.
    c. Start, warm up, operate, and shut down a crane.
    d. Extend outriggers.

OBJECTIVE SHEET

e. Spot crane, lift, swing, and lower load.

f. Replace wire rope.

g. Perform a basic job using dragline.

h. Reeve a clamshell.

i. Perform an intermediate job using clamshell.

j. Secure clamshell for travel and parking.

k. Perform dragline operations on unstable soil.

l. Change lagging.

CRANES AND ATTACHMENTS
UNIT VI

SUGGESTED ACTIVITIES

I. Suggested activities

  A. Order materials planned to supplement unit.

    1. Films

      a. *Cranes: Safety in the Balance*. Color, 24 minutes, 16 mm. Available from MacMillan Association Films, 866 3rd Ave., New York, New York 10022.

      b. *Craning with Confidence*. Color, 17 minutes, International Film Bureau Inc., 1980. Available from International Film Bureau Inc., 332 South Michigan Ave., Chicago, Illinois 60604.

      c. *The Weakest Link*. Color, 18 minutes, International Film Bureau Inc., 1978. Available from International Film Bureau Inc., 332 South Michigan Ave., Chicago, Illinois 60604.

    2. Operator's manuals

      a. Galion Manufacturing Co., Division of Dresser Industries, Galion, Ohio 44833.

      b. Garwood Division--Sargent Industries, 32500 Van Born Road, Wayne, Michigan 48184.

      c. Koehring Company, 780 N. Water St., Milwaukee, Wisconsin 53201.

    3. Safety manual--*User's Safety Manual: Crane*. Construction Industry Manufacturer's Association, 111 E. Madison Avenue, Milwaukee, Wisconsin 53202, 1975.

  B. Make transparencies.

  (NOTE: Make additional transparency masters showing cab controls and reeving procedures from operator's manuals on cranes students will be using.)

  C. Provide students with objective sheet.

  D. Provide students with information and job sheets.

  E. Discuss unit and specific objectives.

  F. Discuss information sheet.

  G. Demonstrate and discuss procedures outlined in job sheets.

  H. Stress to students that manipulation of controls and operating procedures may differ with various models and manufacturers.

SUGGESTED ACTIVITIES

I. Review hand signals.

(NOTE: Hand signal transparencies can be found in Unit XVIII, "Rigging.")

J. If unit on rigging has not been completed, provide students with sufficient information to understand this unit and complete job sheets.

K. Arrange a field trip for students to observe crane operation.

L. Provide alternative jobs if jobs in the job sheets are not practical.

M. Give test.

II. Instructional materials

A. Objective sheet

B. Suggested activities

C. Information sheet

D. Transparency masters

1. TM #1--Sample Load-Rating Chart
2. TM #2--Sample Operating-Radius Chart

E. Job sheets

1. Job Sheet #1--Perform Prestart Inspection and Maintenance Procedures on a Truck-Mounted Cable Crane
2. Job Sheet #2--Service a Crane
3. Job Sheet #3--Start, Warm Up, Operate, and Shut Down a Crane
4. Job Sheet #4--Extend Outriggers
5. Job Sheet #5--Spot Crane, Lift, Swing, and Lower Load
6. Job Sheet #6--Replace Wire Rope
7. Job Sheet #7--Perform a Basic Job Using Dragline
8. Job Sheet #8--Reeve a Clamshell
9. Job Sheet #9--Perform an Intermediate Job Using Clamshell
10. Job Sheet #10--Secure Clamshell for Travel and Parking
11. Job Sheet #11--Perform Dragline Operations on Unstable Soil
12. Job Sheet #12--Change Lagging

F. Test

G. Answers to test

SUGGESTED ACTIVITIES

III. Unit references

A. *Department of the Army Technical Manual TM5-331B.* Washington, D.C.: Headquarters, Department of the Army, 1968.

B. Dickie, D. E. *Crane Handbook.* Ontario, Canada: Construction Safety Association of Ontario, 1975.

C. *Interservice Training Plan of Instruction: Construction Equipment.* Fort Belvoir, Virginia: United States Army Engineer School, 1975.

D. *Maintenance, Parts and Instruction Manual.* Des Moines, Iowa: Little Giant Crane and Shovel, Inc., n.d.

E. Nicholas, H. L., Jr. *Moving the Earth.*, 3rd ed. Greenwich, Connecticut: North Castle Books, 1976.

CRANES AND ATTACHMENTS
UNIT VI

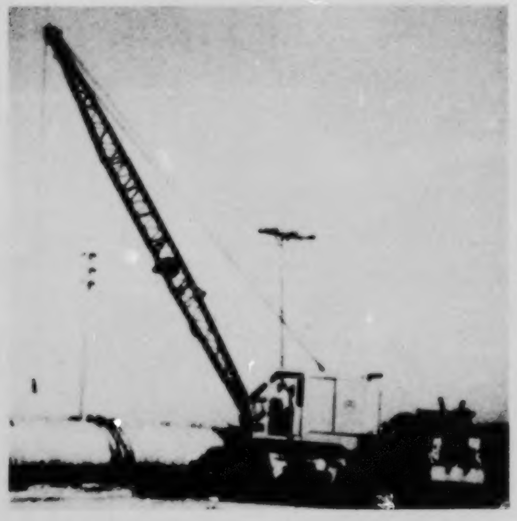
INFORMATION SHEET

I. Terms and definitions

A. Crane--Unit used primarily for lifting an object or load, transferring load to a new location by swinging or traveling, and then placing load in new location

EXAMPLE: Cable crane

FIGURE 1



Courtesy of the Oklahoma Department of Transportation.

B. Attachments--Accessories used to increase a machine's versatility and effectiveness

C. Dragline--Bucket attachment connected to crane by cable arrangement; used to excavate and clean

D. Clamshell--Bucket attachment with hinged jaws

E. Sheave--Grooved wheel used to support wire rope or change its direction of travel

F. Boom--Heavy beam that is hinged at one end and has a weight-lifting device at the other end

G. Outriggers--Outward extensions of frame supported by a jack or block; used to make equipment more stable

INFORMATION SHEET

H. Hook block assembly--Safety hook, bearing block, thrust bearing, brass bushing, and side weights

I. Cast--To move by throwing

J. Taut--Having no "give" or slack; tight

K. Reeving--Threading or placing working lines

L. Lagging--Grooved wrap-around plate on cable drum

M. Gantry--Overhead structure that supports machines or operating parts

N. Pendant--Fixed-boom support cable

O. Pawl (dog)--Tooth or set of teeth designed to lock against a ratchet

(NOTE: The pawl is used to lock into cogs of turntable to hold the rotating part of the unit in one position. Some types of cranes use dogs to lock in drum cogs and hold loads at the desired height.)

P. Automatic tagline--Line from crane boom to clamshell bucket; holds bucket and keeps it from spinning out of position

Q. Counterweight--Dead or nonworking load attached to one end of machine to balance weight carried on opposite end

R. Back stays--Braces

S. Operating radius--Horizontal distance measured from cab's rotation axis to a vertical line extending from outside edge of boom head sheave (Transparency #2)

T. Dead end--End of cable that attaches to drum

U. Live load--Load being lifted

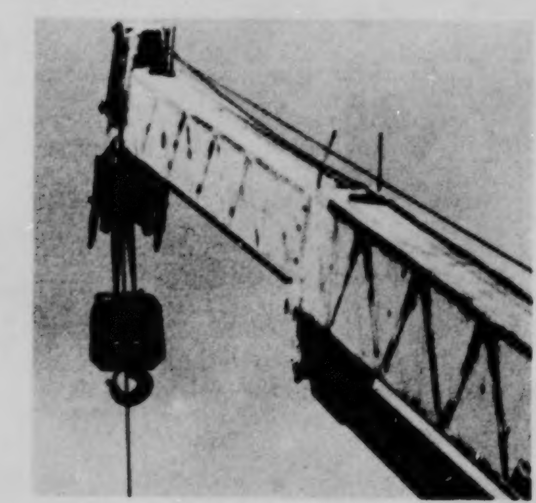
INFORMATION SHEET

II. Crane accessories and/or attachments used in highway maintenance (Figures 2-5)

(NOTE: When changing attachments, the operator must rereeve all the cables. Therefore, the operator must be able to read, understand, and follow rereeving diagrams in the operator's manual. Other attachments, such as the backhoe, shoveldipper, and boom extensions, are also used in construction work.)

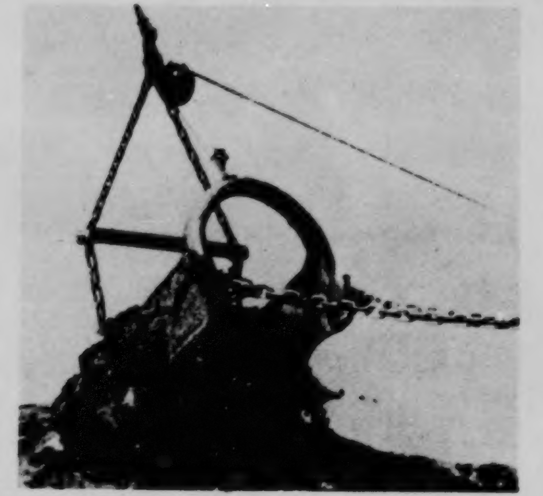
A. Crane hook--Used to lift and relocate objects such as sign trusses and equipment

FIGURE 2



B. Dragline--Used to clear channels and clean ditches

FIGURE 3



Courtesy of Esco Corporation.

INFORMATION SHEET

C. Clamshell--Used to stockpile materials

FIGURE 4

Courtesy of Esco Corporation.

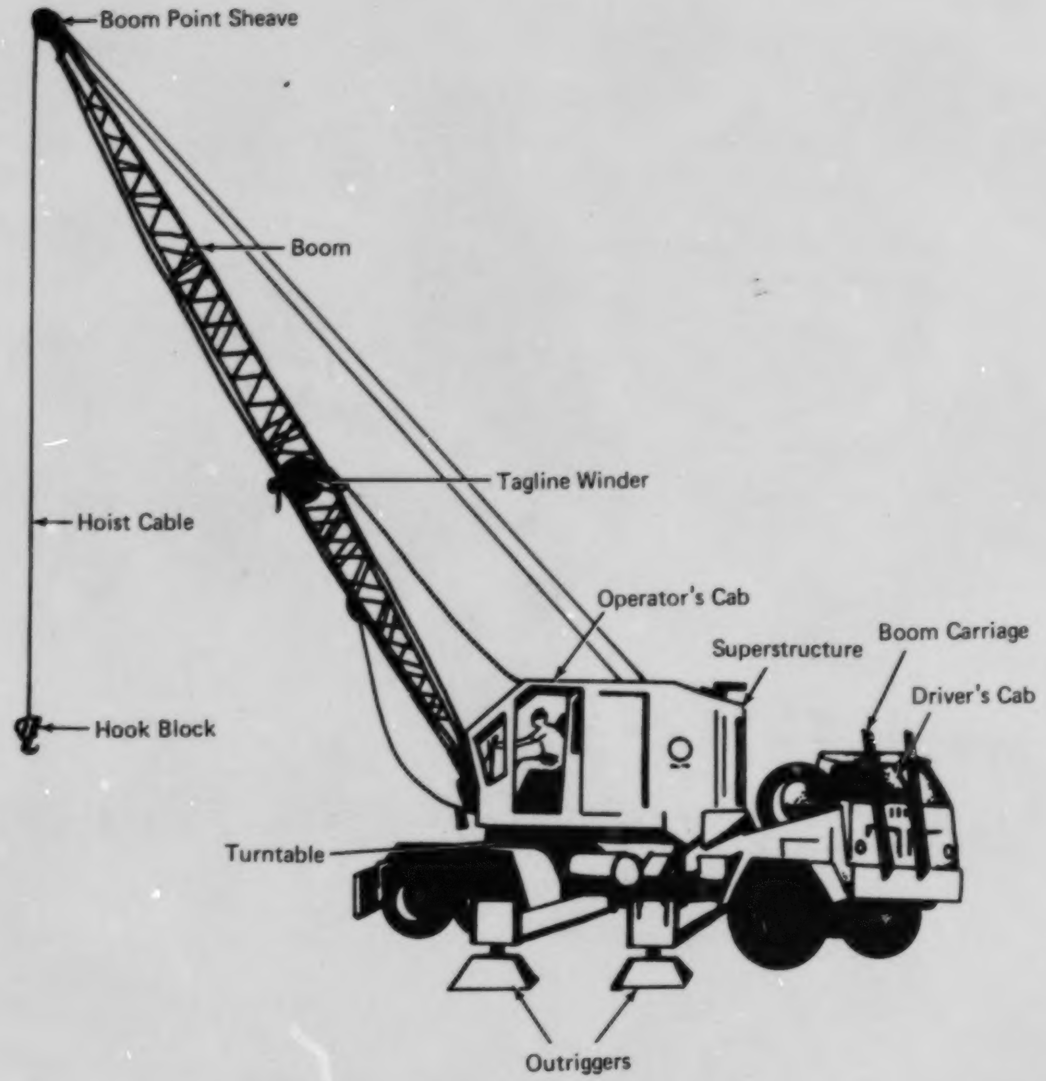
D. Pile driver--Used to drive posts or beams into the ground

FIGURE 5

INFORMATION SHEET

III. Parts of a truck cable crane (Figure 6)

FIGURE 6


Boom Point Sheave
Boom
Tagline Winder
Hoist Cable
Operator's Cab
Superstructure
Boom Carriage
Driver's Cab
Hook Block
Turntable
Outriggers

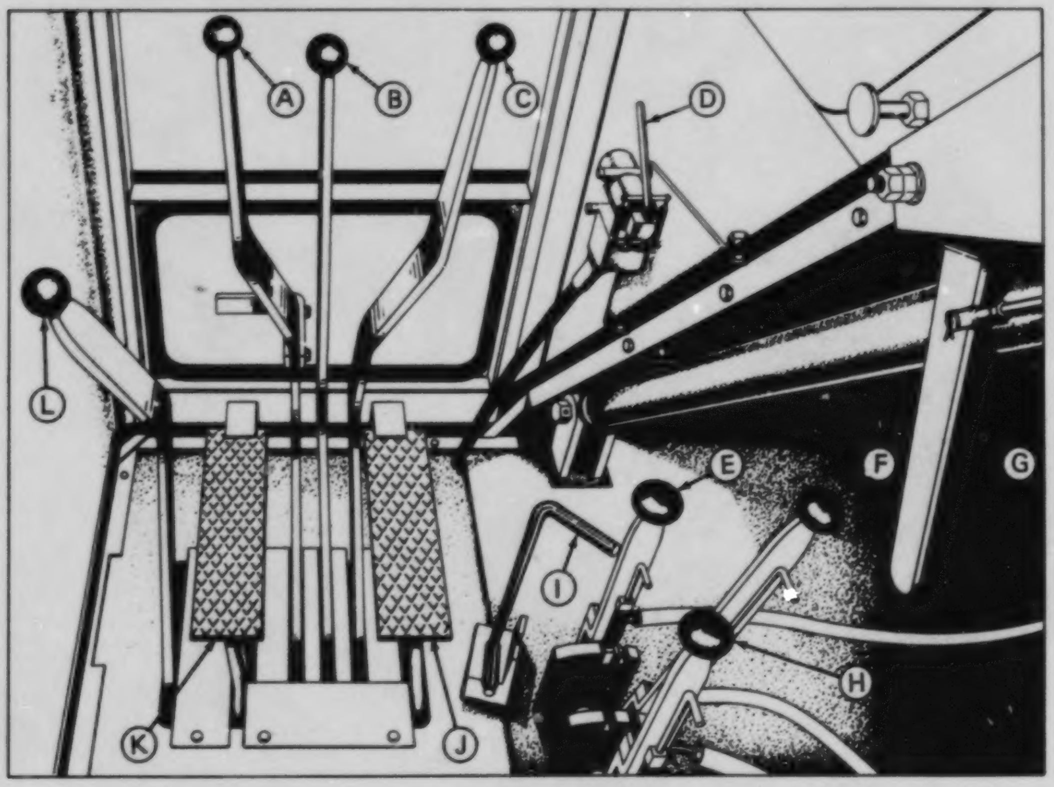
INFORMATION SHEET

IV. Cab controls and functions on a typical crane (Figure 7)

(NOTE: Controls will vary with each manufacturer. Figure 7 illustrates a 20-ton, truck-mounted Garwood crane. Functions of the levers are similar for most models.)

EXAMPLE:

FIGURE 7



A. Boom hoist--Raises and lowers crane boom

(NOTE: This lever is also the power-down lever for lowering a heavy load, and the crowd and retract lever for a shovel dipper.)

B. Right hoist-drum lever--Operates drag drum on a dragline and closing drum on a clamshell

(NOTE: This lever will also operate the pull-down on a backhoe and may be used as an auxiliary hoist drum when using a piledriver.)

C. Left hoist-drum lever--Used for hoisting the load by controlling left hoisting drum

D. Dipper trip lever--Used to trip the shovel dipper

INFORMATION SHEET

E. Boom-hoist clutch lever--Used in conjunction with boom-hoist lever to raise and lower crane, dragline, clamshell, or piledriver boom

F. Power-down clutch lever--Used in conjunction with boom-hoist lever to lower loads under power

G. Throttle lever--Used to control engine speed

H. Crowd-and-retract clutch lever--Used in conjunction with boom-hoist lever to crowd and retract shovel dipper

I. Swing-lock lever--Used to lock revolving frame in position and prevent it from turning on its base

J. Left hoist brake pedal--Used to brake left-hand hoist drum

K. Right hoist brake pedal--Used to brake right-hand hoist drum

L. Swing clutch lever--Used to swing crane in desired direction

M. Master clutch lever (not illustrated)--Used to engage and disengage master clutch

(NOTE: The master clutch lever is located in the operator's cab, behind and to the right of operator's seat.)

V. General safety rules for operating heavy equipment

A. Read operator's manual thoroughly: know your machine

B. Wear safety items required by job conditions

C. Know and observe hand signals

D. Be sure all safety guards and covers are secure and in place

E. Do not operate machine until you are sure area is clear of personnel and obstructions

F. Check all safety devices before moving machine

G. Do not jump on or off machine

H. Mount and dismount properly, using handholds and steps

I. Do not allow anyone to ride on machine

J. Know traffic pattern of job and obey spotter

K. Always park on level ground if possible

L. Do not leave engine running unattended

M. Avoid operating too close to banks or overhangs

N. Stay clear of raised machine parts

INFORMATION SHEET

VI. Safety factors for setting up a crane

(NOTE: Work safely, be alert--accidents cost, accidents hurt.)

A. Operate equipment safely to protect yourself, the public, all personnel, and property from injury or damage

(CAUTION: Do not walk under suspended loads.)

B. Consider job site accessibility and safeness

C. Determine whether equipment will have to travel over ditches where pipe may be damaged

D. Allow sufficient room for erection and maneuverability

E. Ensure ample storage room for booms and components without interfering with maneuvers

F. Know the crane's maximum operating radius

(NOTE: There should be at least two feet clearance between counterweight and obstacles.)

G. Determine that operating location is level and solid

H. Know what excavations, slopes, trenches, or embankments are near the location

I. Make sure that you have a clear view of other equipment

J. Know location of power lines within work area

(CAUTION: Do not operate within 10 feet of power lines. The boom does not have to come in direct contact with wires to act as a conductor. If operating near power lines, power should be shut off, or lines should be insulated.)

K. Store crane with boom lowered

VII. Equipment-handling hazards or conditions that lead to hazards

(CAUTION: Stay clear of suspended loads.)

A. Dropping or slipping of load

B. Breaking cables

C. Failure to use outriggers

D. Faulty or poorly adjusted brakes and clutches

E. Clutch or brake slippage increasing boom radius

F. Job exceeding safe boom radius

INFORMATION SHEET

G. Job exceeding capacity of crane

H. Operating with bent or damaged boom

I. Failure to use safety-type hooks

VIII. Information the operator needs to determine equipment capabilities (Transparencies #1 and #2)

(NOTE: This information is found on a plate inside the cab.)

A. Crane model number, serial number, and date of manufacture

B. Load ratings for main boom at all stated radii

C. Boom angles

D. Boom lengths

E. Boom types

F. Work areas for which capacities are listed in chart

IX. Procedures for effective crane operation

A. Perform prestart inspection and maintenance procedures

B. Be sure footing is adequate

C. Position crane for shortest possible swing where repetitive lifting is involved

D. Level footing to avoid swinging uphill or downhill

(NOTE: Leveled footing decreases power requirement and increases speed and safety.)

E. Use taglines on bulky loads to avoid excessive swinging of load

F. Use adequate lengths of hoist line to assure that block will travel to lowest point required

G. Organize work for minimum travel time

(NOTE: As far as possible, lifts needed in one area should be completed before moving to a new location.)

H. Use power-down device, if available, when precise load handling is required

I. Do not use excessive counterweight or tie-down devices to increase stability

(NOTE: Excessive stress and equipment failures will result.)

INFORMATION SHEET

J. Lift load with boom in highest position possible

K. Raise hook block before raising boom

(NOTE: If boom is raised first, load will drag on the ground.)

X. Procedures for hoisting a load

(NOTE: Lifting should be done over the rear. Truck cab and engine will provide additional counterweight. Generally, lifting should not be performed over the front because visibility is poor and there is the possibility of damage to the front suspension system. Place truck transmission in neutral during lifting to prevent possible damage to the gears when the unit rocks.)

A. Position boom

B. Attach load

C. Hoist load

D. Swing crane with load

(NOTE: With practice, you can hoist and swing load at the same time.)

E. Spot load

(NOTE: Spotting the load requires accurate control of hoist and swing. It takes practice to locate the load at the exact spot without hunting or overshooting.)

F. Lower load

G. Detach hook

XI. Principles of hoisting

A. Load must be well secured and properly balanced in sling or lifting device before it is lifted more than a few inches

B. All rigging equipment must be of sufficient size and in good condition

(NOTE: Improperly sized wire rope will cause grooves in the sheaves and stress on the rope.)

C. Multiple-part lines must not be twisted around each other

(NOTE: Reeving must be in accordance with manufacturer's instructions.)

D. Wire rope must be properly seated in sheaves, tightly spooled, and seated on drum before a load or bucket is moved

(NOTE: Improperly seated or spooled wire rope will wear and will not spool properly, creating hazardous conditions.)

INFORMATION SHEET

E. Hoist line must never be used to wrap load in place of a sling or chain

F. Hoist line must be vertical before starting to lift

G. Never lower load or boom past point where two full wraps of wire rope remain on drums

H. Check capacity and wire rope length each time rope or boom length is changed

I. In tight areas, make a "dry run" with a spotter

(NOTE: This will help to determine the safest way to operate under existing conditions.)

J. Use a minimum of a three-point hitch to prevent a top-heavy load from rolling or tipping

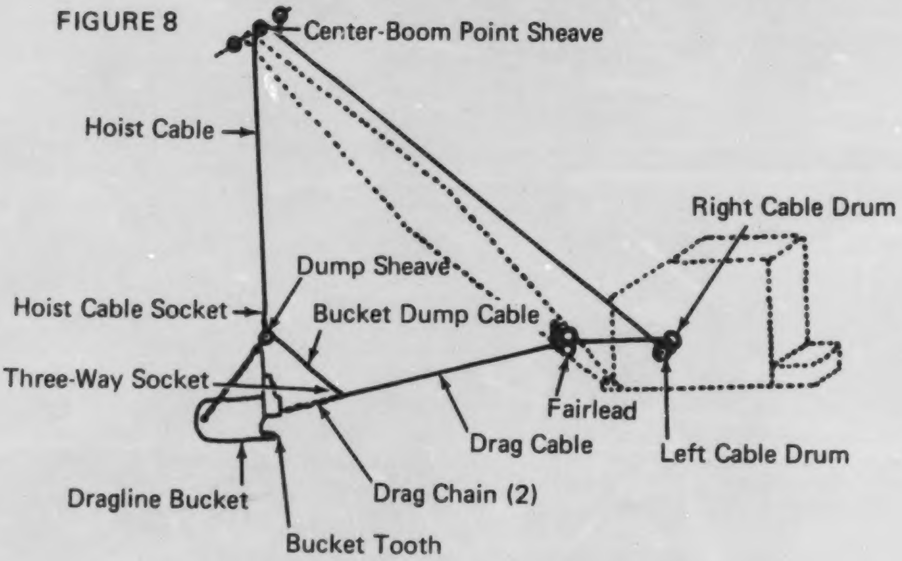
K. To determine total weight, add weight of hook block, slings, and all material-handling devices to weight being lifted

L. Establish capacity, weight, and working radii and stay within those limits

XII. Typical dragline system (Figure 8)

(NOTE: The dragline is a bucket pulled by a drag rope for digging operations. When the bucket has been raised and moved to the dump point, it is emptied by releasing the tension on the drag rope. The dragline is not weighted or held in alignment by rigid structures, so it can bounce, tip over, or drift sideways when it hits hard materials. For dragline operations, a fairlead assembly, which guides the wire rope onto the drum during loading, must be added to the crane.)

FIGURE 8


Center-Boom Point Sheave
Hoist Cable
Right Cable Drum
Dump Sheave
Hoist Cable Socket
Bucket Dump Cable
Three-Way Socket
Fairlead
Drag Cable
Left Cable Drum
Dragline Bucket
Drag Chain (2)
Bucket Tooth

INFORMATION SHEET

XIII. Procedures for effective dragline operation

A. Position machine to eliminate unnecessary casting and hoisting

(NOTE: This is a wise practice even though a dragline bucket can be readily cast beyond the length of the boom.)

B. Use heavy timber mats for work on soft ground

C. When positioning dragline, allow access for maintenance, operating personnel, and hauling equipment

D. Excavate in layers, not in trenches

E. Keep work area sloped upward toward machine

F. Do not drag bucket in so close to machine that it will build up piles and ridges of material in front of machine

G. Salvage used pieces of hoist and drag rope to use as dump rope

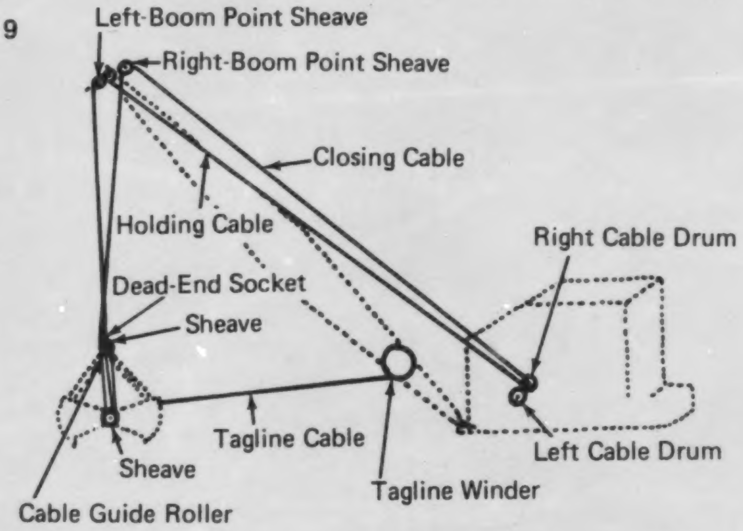
H. Never guide bucket by swinging superstructure while digging

(NOTE: This puts side stress on the boom and can cause failure. The swing should not be started until bucket has cleared.)

XIV. Typical clamshell system (Figure 9)

(NOTE: The clamshell bucket consists of two scoops hinged together. Counterweights are bolted around the hinge. The bucket is controlled by the holding, closing, and taglines. At the start of the digging cycle, the bucket rests on the material with the shells open. As the closing-line wire rope is wound up on the drum lagging, the shells are drawn together, causing them to dig into the material. The bucket is then raised by the holding and closing lines and swung to the dumping point where it is opened by releasing the tension on the closing line. A secondary hoist line and a tagline must be added for clamshell operations.)

FIGURE 9


Left-Boom Point Sheave
Right-Boom Point Sheave
Closing Cable
Holding Cable
Right Cable Drum
Dead-End Socket
Sheave
Tagline Cable
Left Cable Drum
Sheave
Tagline Winder
Cable Guide Roller

INFORMATION SHEET

XV. Procedures for effective clamshell operation

(NOTE: The effective use of the clamshell means an efficient cycle of digging, hoisting, swinging, and dumping. Large buckets may increase cycle time.)

A. Position unit on level ground when possible

B. Position unit so that clamming or digging operation is at same radius as dumping operation

(NOTE: This avoids excessive wear on the boom mechanism and waste of production time by raising and lowering the boom.)

C. Select correct bucket size for machine

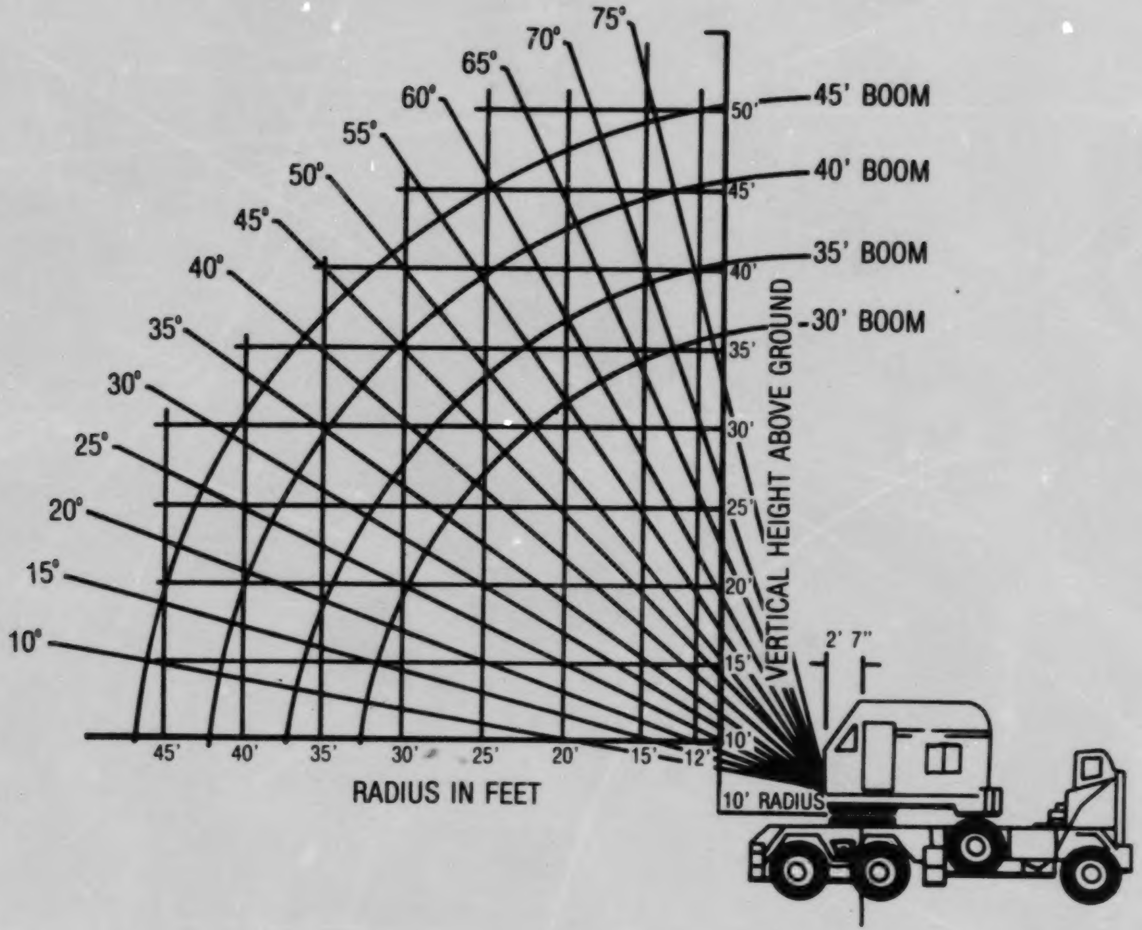
Sample Load Rating Chart

RATED LOADS IN POUNDS FOR STANDARD BOOM					
1	2	3	4	5	6
Boom Length In Feet	Radius In Feet	Boom Angle In	With Outriggers Over Back & Side	Without Outriggers	
				Over Back	Over Side
30	10	75°	40000	27700	24300
	12	71°	33200	22300	18800
	15	65°	26300	17200	13900
	20	54°	19500	12300	9750
	25	41°	14500	9500	7400
	30	23°	12000	7900	5950
35	12	74°	33100	22200	18700
	15	69°	26200	17100	13800
	20	60°	19400	12200	9650
	25	50°	14400	9400	7300
	30	38°	11900	7800	5850
	35	22°	9900	6400	4700
40	15	72°	26100	17000	13700
	20	64°	19300	12100	9550
	25	56°	14300	9300	7200
	30	46°	11800	7700	5750
	35	35°	9800	6300	4600
	40	20°	8400	5200	3800
45	15	74°	26000	16900	13600
	20	67°	19200	12000	9450
	25	60°	14200	9200	7100
	30	52°	11700	7600	5650
	35	44°	9700	6200	4500
	45	33°	8300	5100	3700
	45	19°	7200	4200	3000

RATED LOADS ARE NOT MORE THAN 85% OF THE TIPPING LOADS WITH CRANE STANDING ON A SUPPORTING SURFACE THAT IS FIRM, LEVEL, AND UNIFORM. WEIGHT OF THE BUCKET, PILEDRIVER, JIB, CHAIN, AND ANY OTHER EXTERNAL AUXILIARY LIFTING MEANS ARE TO BE INCLUDED AS PART OF THE HOOK LOAD.

WHEN USING CLAMSHELL OR DRAGLINE BUCKET UNDER STICKY OR WET CONDITIONS, AS MUCH AS 20% OF LIFTING CAPACITIES MUST BE DEDUCTED BECAUSE OF SUCTION OR STICKY MATERIALS.

Sample Operating Radius Chart



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CRANES AND ATTACHMENTS
UNIT VI

JOB SHEET #1--PERFORM PRESTART INSPECTION AND MAINTENANCE PROCEDURES ON A TRUCK-MOUNTED CABLE CRANE

I. Equipment and materials

   A. Truck-mounted cable crane

   B. Operator's manual

   C. Engine oil

   D. Engine coolant

   E. Hydraulic fluid

   F. Fuel

   G. Lubricants

   H. Grease gun

   I. Rags

II. Procedure

(NOTE: Deficiencies should be corrected immediately or reported to the proper authority. Do not operate defective equipment.)

   A. Make a walk-around visual inspection for leaks and broken, worn, or missing parts

   B. Check engine oil level; add or change oil if needed

   C. Check engine coolant level; add coolant if needed

   D. Check hydraulic reservoir level; add fluid if needed

   E. Check fuel level; fill tank if necessary

   F. Check battery connections for tightness and corrosion

   G. Check battery electrolyte level; add water if needed

   H. Clean air cleaner; remove and clean filter if necessary

   I. Check brakes

   J. Check tires

   K. Clean all grease fittings and lubricate according to manufacturer's specifications

JOB SHEET #1

L. Check hydraulic system for leaking lines and connections, bent or kinked lines, and lines rubbing against other parts

M. Check drive belts for tightness

N. Check electrical wire connections and insulation

O. Clean windshield and mirrors; adjust mirrors

P. Check gauges

Q. Check foot pedals for proper functioning

R. Check levers and controls for proper functioning

S. Remove trash

T. Check lights

U. Check safety devices

V. Check major components

  a. Reeving and cables

  b. Booms and attachments

CRANES AND ATTACHMENTS
UNIT VI

JOB SHEET #2--SERVICE A CRANE

I. Equipment and materials

A. Crane and attachment

B. Tool kit

C. Grease gun

D. Air supply

E. Lubricants

F. Cleaning solvents

G. Rags

H. Water

I. Engine coolant

J. Fuel

K. Tire pressure gauge

L. Brake fluid

II. Procedure

(NOTE: Follow departmental preventive maintenance program when servicing equipment. Refer to operator's manual for lubrication chart and for servicing specific components and attachments.)

A. Visually inspect for leaks and broken, worn, or missing parts

(NOTE: Items found damaged, worn, or missing should be reported and repaired.)

B. Check engine oil level, filter, lines, and hoses; add engine oil if needed

C. Check air cleaner filter (element); clean or replace if necessary

D. Check engine coolant level, radiator cap, hose, and radiator; add coolant if needed

(CAUTION: Do not remove radiator cap unless engine is cool; then, open cap slowly to release pressure.)

E. Check fuel level, fuel filters, and sediment bowl (where applicable); fill fuel tank if necessary

JOB SHEET #2

F. Check battery electrolyte level, battery cables, and connectors; add water or electrolyte if needed

(CAUTION: Keep sparks and fire away from battery.)

G. Check exhaust system for loose connections and holes

H. Check hydraulic fluid level, filters, hose, lines, and fittings; look for leaks; add fluid if needed

I. Check transmission fluid level; add fluid if needed

J. Check transmission pressure line filter and breather

K. Check brake adjustment and condition; adjust if necessary

L. Check brake master cylinder fluid level; add fluid if needed

M. Check clutch adjustment; adjust if necessary

N. Check drive belts for tension and wear; adjust or replace if necessary

O. Check wiring, insulation, and connections

P. Clean and lubricate grease fittings

Q. Check tires for wear and pressure; inflate as needed

R. Check all safety devices; repair if necessary

S. Check windshield and windshield wipers; clean if necessary

T. Check major components and/or accessories

U. Check gauges and controls to be sure that they are functioning properly

V. Lubricate steering cylinder bearings

W. Check components of upper frame

X. Check components of lower frame

Y. Check booms and attachments

Z. Check all drums and cables; lubricate if necessary

AA. Check hook block assembly

CRANES AND ATTACHMENTS
UNIT VI

JOB SHEET #3--START, WARM UP, OPERATE, AND SHUT DOWN A CRANE

I. Equipment

   A. Crane

   B. Operator's manual

II. Procedure

   A. Perform prestart inspection and maintenance procedures

   B. Mount crane properly

   C. Fasten seat belt

   D. Push engine clutch lever forward to disengage clutch

   E. Advance hand throttle lever halfway

   F. Use choke as required (if applicable)

   G. Turn ignition switch on

   H. Depress starter button

   (NOTE: In cold weather, check operator's manual for cold-weather starting procedures.)

   I. Release starter button when engine starts

   (CAUTION: Do not crank engine more than twenty second without a two-minute cooling period. If engine fails to start after a few tries, determine cause and correct before trying again.)

   J. Pull out throttle control to maintain fast idle speed

   K. Open choke

   L. Check for abnormal noise or operation

   M. Check temperature gauge for correct temperature

   N. Check engine oil pressure for correct operating pressure

   O. Check voltmeter for plus reading

   P. Check tachometer for correct rpm

   Q. Check front and rear clutch

   R. Check boom hoist clutch

JOB SHEET #3

S. Check front and rear drum brakes

T. Check boom hoist brake

U. Check all controls for proper operation

(NOTE: Engage or disengage dog or pawl according to job requirements.)

1. Revolve frame
2. Lock frame in position
3. Raise and lower boom
4. Hoist and lower load
5. Swing crane to left and right; then bring it back to center

V. Lower load to ground

W. Disengage engine clutch lever

X. Close hand throttle

Y. Turn off ignition switch

Z. Dismount properly

AA. Make walk-around visual inspection

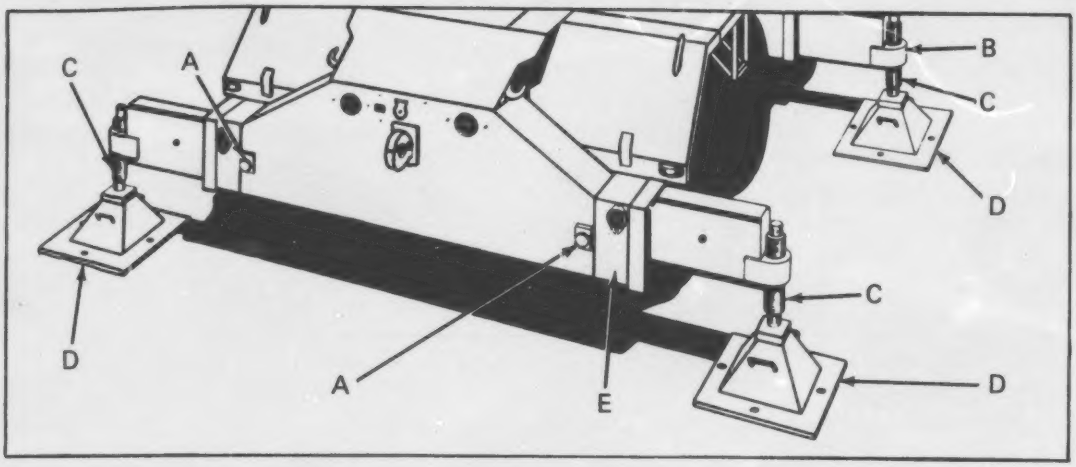
CRANES AND ATTACHMENTS
UNIT VI

JOB SHEET #4--EXTEND OUTRIGGERS

I. Equipment--Crane

II. Procedure (Figure 10)

FIGURE 10



a.	LOCK PIN	d.	JACK FLOAT
b.	OUTRIGGER	e.	OUTRIGGER FRAME
c.	JACKSCREW		

A. Remove lock pins (a)

B. Slide the outriggers (b) out until you can reinsert lock pins

(CAUTION: Use caution when pulling outriggers out of frame [e]. They may slide completely out of the frame and fall on your feet.)

C. Place jack float (d) under jackscrew (c)

D. Screw jackscrew down onto jack float until tight

CRANES AND ATTACHMENTS
UNIT VI

JOB SHEET #5--SPOT CRANE, LIFT, SWING, AND LOWER LOAD

I. Equipment

- A. Crane
- B. Load
- C. Spotter
- D. Wheel blocks

II. Procedure

- A. Spot crane
  1. Move crane to load
  2. Position crane so that most of work will be performed over rear
  3. Set crane brakes
  4. Block wheels
  5. Extend and set outriggers
- B. Lift load
  1. Engage boom hoist clutch lever
  2. Position boom over center of load

     (NOTE: Do not exceed angle.)
  3. Determine load level
  4. Move lever to neutral

     (NOTE: Boom hoist brake will hold boom in this position.)
  5. Allow spotter to attach hook block to load

     (NOTE: Do not proceed until spotter is clear of area.)
  6. Release left drum brake while engaging hoist lever
  7. Hoist load to desired height
  8. Apply brake and move lever to neutral

JOB SHEET #5

9. Lock brake to prevent load from falling

   (CAUTION: Never get out of the crane with a live load while the brakes are locked in position. Stay in crane when load is suspended.)

C. Swing load

(NOTE: Keep left hoist brake on while swinging.)

1. Engage swing clutch lever to swing to right

   (NOTE: Engage slowly so that swing will be smooth.)

2. Engage lever gently in opposite swing position to stop swing

   (CAUTION: Never stop swing with swing brake.)

3. Engage swing-lock lever to keep cab from drifting

D. Spot and lower load

1. Be sure swing lock and hoist brakes are engaged
2. Raise or lower boom with boom-hoist lever as necessary to accurately place load
3. Release left hoist brake, and control lowering of free-falling load with brake and left hoist lever

   (CAUTION: Heavy loads should be moved more slowly by using power-down device such as a snatch block; this will lower load under power.)

CRANES AND ATTACHMENTS
UNIT VI

JOB SHEET #6--REPLACE WIRE ROPE

I. Equipment, materials, and personnel

A. Cable crane

B. Reel or coil of wire rope, correct size for replacement

C. Gloves

D. Manufacturer's service manual

E. Wire ties

F. Driving punch

G. Hammer

H. Pry bar or screwdriver

I. Helper

II. Procedure

(CAUTION: Always wear gloves when handling wire rope.)

A. Lower boom

B. Stop engine; disengage hoist brake and clutch

C. Check service manual diagram

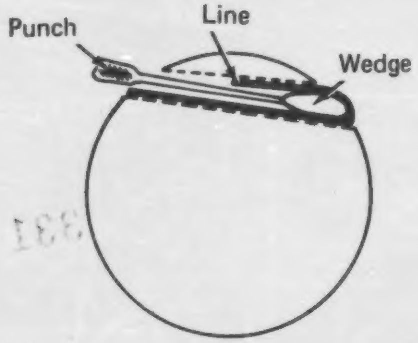
(NOTE: It is of the utmost importance that you know the *exact* layout. Study the diagram and make sure you understand it. If no diagram is available, make an accurate sketch.)

D. Pull old line from hoist line drum

E. When wire rope is off drum, except for anchored end, turn drum by hand to a convenient position

F. Release wire rope from drum anchor by placing driving punch against small flat end of wedge and hammering until wedge is loose (Figure 11)

FIGURE 11



JOB SHEET #6

G. Pull wire rope out of socket with pry bar or screwdriver

H. Repeat procedure on boom drum anchor

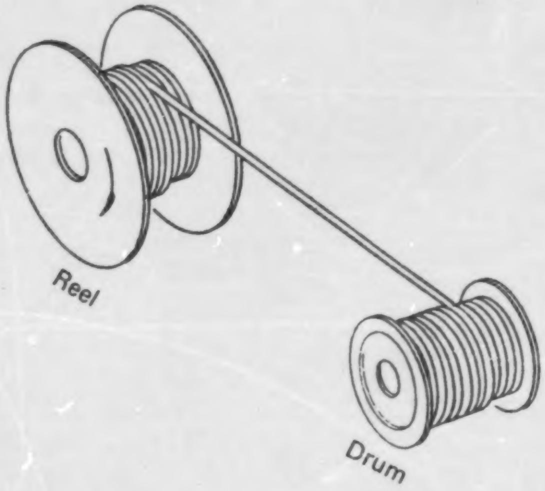
I. Roll old line into a coil and tie securely with wire ties

(CAUTION: A loose cable is a hazard.)

J. Unreel or uncoil new wire rope

(NOTE: A wire rope can be permanently damaged even before it has gone into operation. Unwinding from a reel the wrong way can put destructive kinks and doglegs in the wire rope. If the reel can be set on jacks, unwind from the *topside* of the reel [Figure 12]. If the wire rope is supplied in a coil, have helper unroll the coil slowly like a wheel, leaving behind a trail of straight rope. [See Figure 13 on next page.] Uncoiling by laying the coil flat and pulling off the top makes rope hard-to-handle and kinky.)

FIGURE 12



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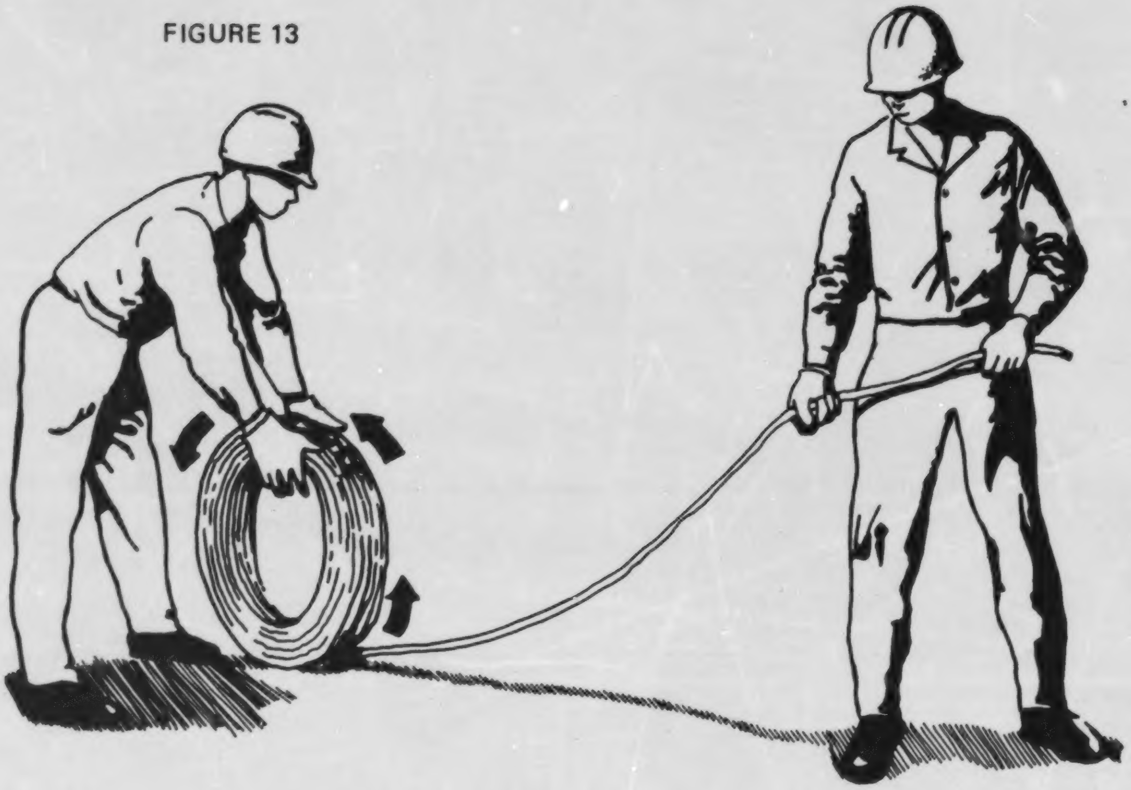
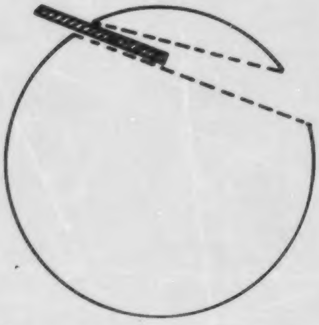
JOB SHEET #6

FIGURE 13



K. Draw new wire rope over proper boom point sheave and push it through small end of anchor socket (Figure 14)

FIGURE 14

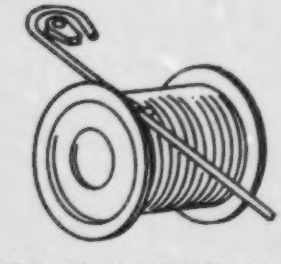


JOB SHEET #6

L. Bend wire rope into a loop and place wedge in loop (Figure 15)

(CAUTION: Make sure that wire rope is not twisted or kinked, but pulled straight back and turned.)

FIGURE 15



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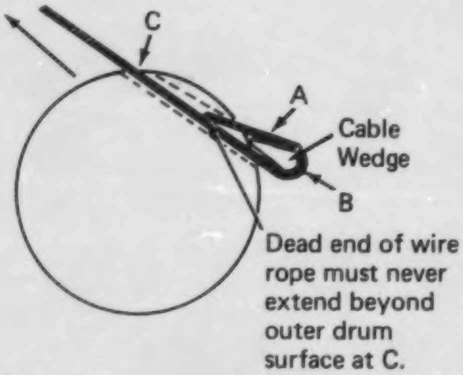
M. Pull slack back through small end, drawing wedge into socket, and making sure that no wire rope extends beyond small end (Figure 16)

FIGURE 16


C
A
Cable Wedge
B
Dead end of wire rope must never extend beyond outer drum surface at C.

Source: Thew Shovel Company.

N. Hammer wedge into socket just enough to hold until wire rope can be firmly seated by tension on the rope

O. Turn drum to reel in line until other end is near bucket sheave

P. Reeve line through bucket sheave over empty boom point sheave

Q. Anchor to boom following same procedure

R. When line is anchored at both ends, start engine and idle

S. Engage hoist clutch to wind slack wire rope onto drum

(NOTE: Wire rope should wrap smoothly, with each loop lying against the previous one. A worker will guide it from near the drum with a gloved hand; a helper can pull the slack down to the bucket sheave and keep light tension on the line from there. Some resistance or back-pull helps it wind snugly.)

JOB SHEET #6

T. Tighten anchor clamps by running empty bucket down and out and stopping it abruptly two or three times with the brake

(NOTE: It is important to keep the wire rope from running slack for the first two hours of operation. When run slack, it is most likely to cross loops on the drum before it is broken in.)

CRANES AND ATTACHMENTS
UNIT VI

JOB SHEET #7--PERFORM A BASIC JOB USING DRAGLINE

I. Equipment

- A. Crane with dragline attachment
- B. Wheel blocks

II. Procedure

- A. Spot crane
    1. Move crane to position
    2. Position crane so that most of work will be performed over rear
    3. Set crane brakes
    4. Block wheels
    5. Extend and set outriggers
- B. Set boom at proper angle
    1. Engage boom-hoist lever to RAISE or LOWER until boom indicator is at desired angle (30 degrees to 78 degrees)
    2. Move lever to NEUTRAL

       (NOTE: Boom hoist brake will hold boom in this position.)
- C. Cast and fill bucket
    1. Engage holding-hoist lever and raise bucket half the distance between ground and boom point
    2. Depress hoist brake and return lever to NEUTRAL
    3. Engage drag lever and pull bucket in toward boom
    4. Release lever and brake pedal at the same time, allowing bucket to cast out beyond boom point

       (NOTE: Reengage brake *lightly* to keep cable from running off drum.)
    5. Engage drag lever, dragging bucket toward crane
    6. Ease up on hoist brake pedal, allowing hoist cable to reel off drum so that bucket teeth continuously bite into ground
    7. When bucket is full, release drag lever and depress both brake pedals

JOB SHEET #7

D. Raise bucket

1. Engage hoist drum lever and release hoist brake pedal
2. As bucket is raised to desired height, ease up on drag brake pedal to hold bucket level and prevent dumping
3. Apply hoist brake and release hoist drum lever; apply drag drum brake

E. Swing bucket

(NOTE: Keep both drag and hoist brakes on.)

1. Engage swing clutch lever to swing right or left toward dump pile

   (NOTE: Engage slowly for smooth swing.)

2. To stop swing, engage lever in opposite swing position

F. Dump load

1. As you approach dump pile, release drag brake pedal, allowing bucket to swing out and dump its load
2. When bucket is dumped, apply drag brake to keep wire rope taut and to prevent unwinding
3. Swing boom back; cast dragline bucket and repeat cycle

CRANES AND ATTACHMENTS
UNIT VI

JOB SHEET #8--REEVE A CLAMSHELL

I. Equipment and materials

A. Crane with 30' boom

(NOTE: If boom length is different, adjust line lengths to accommodate boom.)

B. Manufacturer's operating and service manuals

C. Clamshell attachment

D. Holding-line wire rope, 75 feet

E. Closing-line wire rope, 105 feet

F. Tagline wire rope, 50 feet, 3/8"

G. Tagline winder

H. Gloves and hard hat

I. Wire rope clamps

J. Cable clamps

K. U-bolts, lockwashers, and nuts

L. Hammer

M. Driving punch

N. Wrenches

O. Lifting device (front-end loader, forklift, etc.)

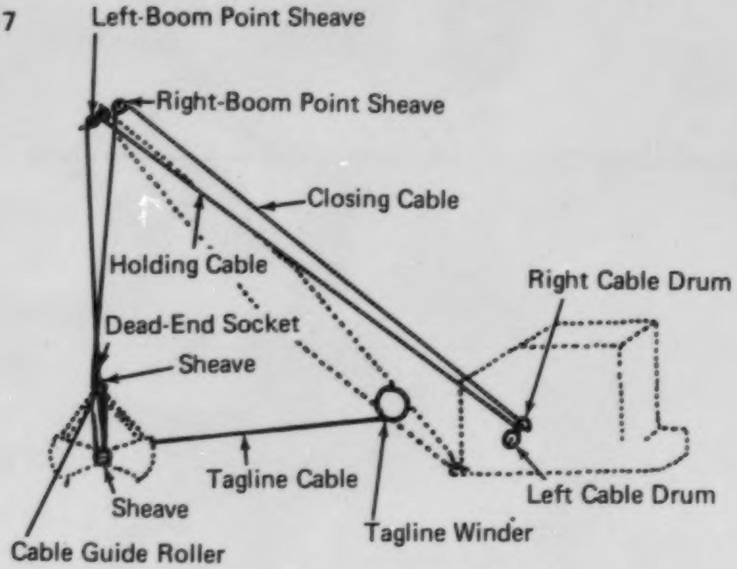
JOB SHEET #8

II. Procedure

A. Consult operator's manual for exact reeving layout and procedures for machine (Figure 17)

(NOTE: The illustration in Figure 17 shows a *typical* clamshell reeving operation. Manufacturers may vary in particular procedures. Be sure to read through your manual carefully and to follow manufacturer's specifications.)

FIGURE 17


Left-Boom Point Sheave
Right-Boom Point Sheave
Closing Cable
Holding Cable
Right Cable Drum
Dead-End Socket
Sheave
Tagline Cable
Sheave
Left Cable Drum
Tagline Winder
Cable Guide Roller

B. Swing boom over clamshell

C. Lower boom to within about six feet of ground beside clamshell

D. Reeve holding line up and over left-boom point sheave and down boom to left cable drum

E. Reeve remaining free end of wire rope through dead-end socket on top of clamshell

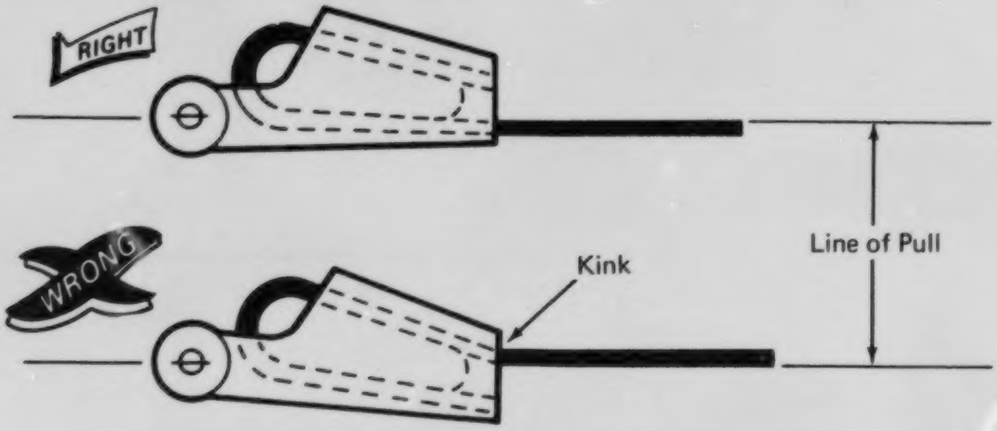
JOB SHEET #8

F. Secure line with a cable wedge socket

1. Insert working portion of wire rope into straight side of wedge socket

   (NOTE: If wire rope is not properly installed, the clamp will bend and weaken it. See Figure 18.)

FIGURE 18



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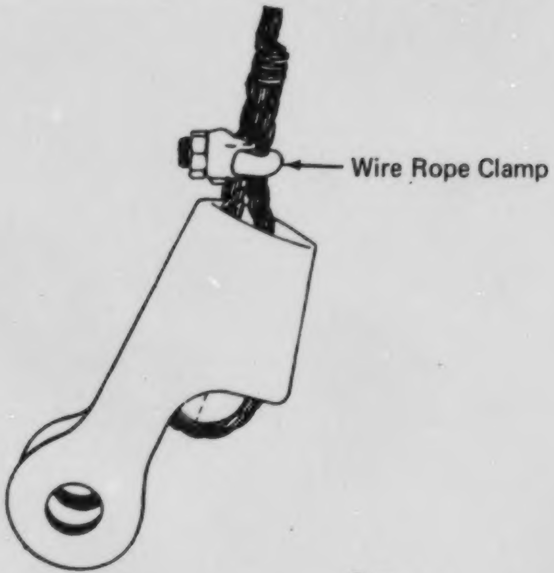
2. Make sure that end of wire rope does not extend past wedge

   (NOTE: End will fray and be hard to work with.)

3. Install wire rope clamp; tighten with a wrench (Figure 19)

FIGURE 19



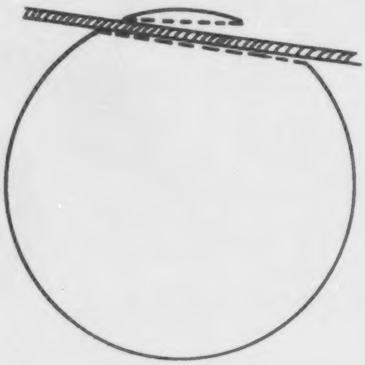
JOB SHEET #8

G. Study machine diagram or Figure 17 (clamshell reeving) until you understand layout of closing line

H. Reeve closing line up and over right-boom point sheave and down boom to right cable drum

I. Secure wire rope to drum by bringing rope straight through small end of anchor socket (Figure 20)

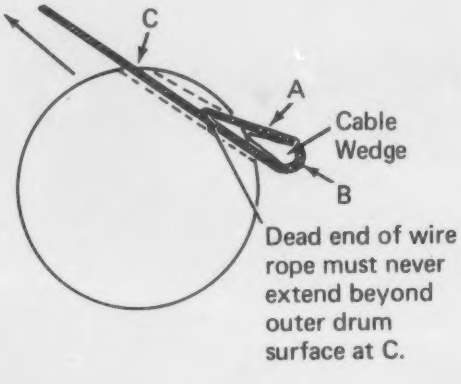
FIGURE 20



J. Loop rope around wedge (do not twist), and pull slack back through small end, drawing wedge into socket (Figure 21)

(NOTE: Pull the wire rope straight through socket and *turn* it around the wedge. Make sure that no wire rope extends beyond socket.)

FIGURE 21


C
A
Cable Wedge
B
Dead end of wire rope must never extend beyond outer drum surface at C.

Source: Thew Shovel Company.

K. Hammer wedge in enough to hold until wire rope is fully seated by line tension

JOB SHEET #8

L. Reeve remaining free end of wire rope through cable guide rollers at top of clamshell

M. Reeve wire rope down and around lower clamshell sheave

N. Reeve wire rope up and around upper clamshell sheave

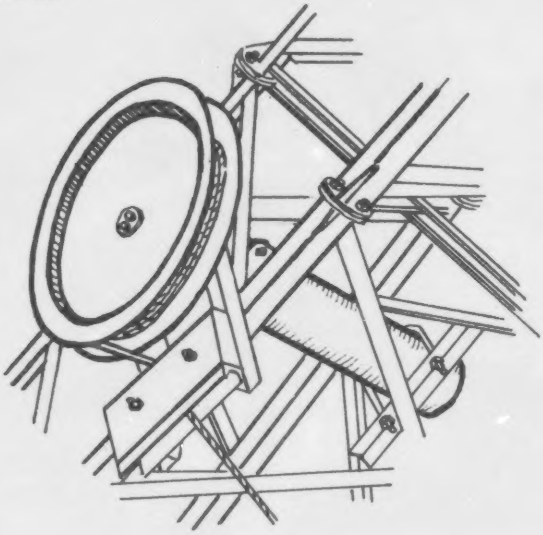
O. Reeve wire rope down through dead-end socket

P. Secure wire rope with a cable wedge (See Figure 18.)

Q. Spool the slack wire rope onto cable drum

R. Install tagline winder (Figure 22)

FIGURE 22



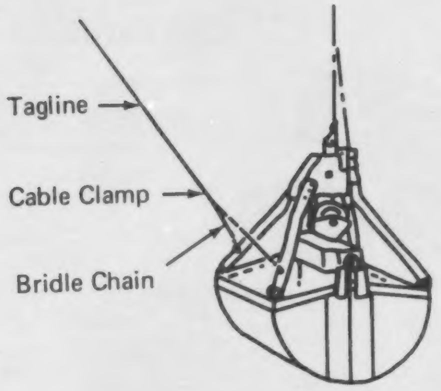
Source: McCaffrey-Ruddock Tagline Corp., Los Angeles.

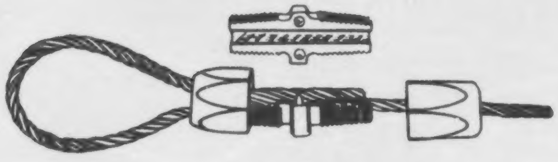
1. Lift tagline winder and slide it through boom about three feet below top of boom foot section
2. Secure tagline winder to boom with a U-bolt, four lockwashers, and four nuts (or according to manufacturer's recommendations)
3. Secure one end of tagline cable to tagline winder
4. Reeve tagline through guide rollers and out to clamshell

JOB SHEET #8

5. Secure tagline to clamshell bridle chain and cable clamps (Figure 23)

FIGURE 23





Cable Clamp

Source of upper portion of Figure 23: Little Giant Products, Inc., Peoria, Illinois.

S. Adjust tagline tension by increasing or decreasing number of cable wraps on tagline winder

(NOTE: Tension should be light enough for a person to guide bucket by hand or with a stick as it is lowered into place.)

T. To change to another attachment, unreeve wire ropes in reverse order

(NOTE: Be sure to roll and tie wire ropes securely. Lubricate, tag, and store them for future use. When undoing the tagline, be careful not to release it suddenly as it may damage the tagline winder.)

CRANES AND ATTACHMENTS
UNIT VI

JOB SHEET #9--PERFORM AN INTERMEDIATE JOB USING CLAMSHELL

I. Equipment

  A. Crane with clamshell attachment

  B. Wheel blocks

II. Procedure

  A. Spot crane

    1. Move crane to position

    2. Set crane brakes

    3. Block wheels

    4. Extend and set outriggers

    5. Check automatic tagline for proper operation

  B. Set boom at proper angle

    1. Engage boom-hoist clutch lever

    2. Engage boom-hoist lever to RAISE or LOWER until boom is in approximate position

    3. Move lever to NEUTRAL

    (NOTE: Boom hoist brake will hold boom in this position.)

  C. Fill clamshell

    1. Lower opened clamshell until it is about one foot above material to be worked

    2. Apply both brake pedals

    3. Release both brake pedals at the same time and drop clamshell

    4. Control digging depth with holding-drum lever

    5. When clamshell is at correct depth, close bucket by engaging closing-line drum lever; at the same time, control digging depth with holding-drum lever until clamshell is closed and loaded

    (NOTE: To decrease depth, engage holding-drum lever; this will raise bucket and decrease the bite.)

JOB SHEET #9

D. Raise load

1. Keep closing-line hoist drum lever engaged

2. Engage holding-drum lever so that wire rope is taken up at the same rate bucket is raised to desired height

   (NOTE: Never allow closing cable to go slack, or clamshell will immediately swing open.)

3. Apply both closing-line and holding-line brake pedals; at the same time, release both the closing-line and holding-line drum levers

   (NOTE: Keep both closing-line and holding-line drum brakes on while swinging.)

4. Engage swing-clutch lever to swing to right or left as desired

   (NOTE: Engage levers slowly for smooth swing.)

5. Gently engage lever in opposite swing position to stop swing

   (NOTE: When bucket is high enough to clear obstacles, start swinging action while raising bucket to desired height.)

E. Dump load

1. Keep holding-line brake pedal firmly depressed; at the same time, release closing-line brake pedal

2. Depress closing-line pedal, and stop cable before bucket halves open far enough to slam against stops

3. As soon as clamshell unloads, swing clamshell back to material

4. Lower open bucket and repeat cycle

   (NOTE: When working with sticky material, the bucket may be opened hard against the stops to dislodge material.)

CRANES AND ATTACHMENTS
UNIT VI

JOB SHEET #10--SECURE CLAMSHELL FOR TRAVEL AND PARKING

I. Equipment--Crane with clamshell attachment

II. Procedure

(NOTE: If the clamshell is to be traveled a long distance, it should be removed from the crane and carried on a truck.)

A. Place boom directly over boom cradle

B. Place swing-lock lever in the engaged position

C. Lower boom until it is about one inch from resting on boom cradle

D. Hoist clamshell as close to boom point as possible without jamming them together or damaging boom point sheaves

(NOTE: The higher you raise the bucket, the more clearance you will have when passing over high spots.)

E. Close clamshell bucket and all cab openings

F. Travel crane to parking area

(NOTE: If you find that the bucket sways too much on the way to the parking area, snub the bucket to one of the tow hooks with a short cable.)

G. Park crane

H. Open bucket and set it on the ground near front of machine, with boom resting in boom cradle

I. Shut down machine

J. Dismount properly

K. If parking for the night, lower boom to ground

CRANE AND ATTACHMENTS
UNIT VI

JOB SHEET #11--PERFORM DRAGLINE OPERATIONS ON UNSTABLE SOIL

I. Equipment, materials, and personnel

   A. Crane

   B. Dragline attachment

   C. Six mats 6-by-6-feet built of 6-by-6-inch timbers lashed together and equipped with lifting rigging, steel cable, or chain

   D. Flatbed truck

   E. Truck operator

   F. Spotter

   G. Sling

II. Procedure

   A. Determine exactly where mats should be placed

   (NOTE: Truck operator should park truck on solid ground far enough away from unstable soil so that crane can remain on solid ground while unloading mats.)

   B. Position crane on solid ground between truck and unstable work area

   C. Lift drag bucket by raising hoist line

   D. Take in dragline to pull bucket toward crane

   E. Swing boom over mats and lower hoist line

   (NOTE: At this point, spotter will attach a short sling from the drag chain to the eye of the cable on one end of the mat. Do not proceed until spotter is clear of area.)

   F. Raise hoist line until mat is clear of truck

   G. Use swing control lever to swing crane into position for setting mat

   H. Lower hoist line until end of mat is in correct position

   I. Continue lowering hoist line until mat is flat on ground

   J. Lower hoist line slightly until sling can be removed from mat

   K. Raise hoist line, and swing bucket to truck to pick up next mat

   (NOTE: If it is necessary to travel some distance over unstable soil, place two rows of mats end to end and spaced far enough apart so that the wheels of the crane truck will track down the center of the mats.)

JOB SHEET #11

L. Repeat lifting and swinging steps, placing mats side by side until all six are in place

(NOTE: After all mats are in place, swing boom around to face direction of travel.)

M. Engage travel clutch and cautiously move crane forward onto mats

N. Travel forward until front wheels are on last mat laid

O. Disengage travel clutch to stop forward motion

P. Engage swing clutch to swing boom around 180 degrees; lower hoist line so that sling can be reconnected to exposed mat

Q. Engage hoist-line clutch to raise mat high enough to clear ground or any obstructions; disengage hoist-line clutch when desired height is reached

R. Engage swing clutch to swing boom around almost 180 degrees; lower hoist line until end of mat rests on ground; depress hoist-line brake

S. Engage swing clutch gradually as boom starts to swing; release hoist-line brake slowly in time with swing, so that mat is laid down in line with the other mats

(NOTE: If swing is faster than lowering of hoist line, mat will be pulled away from the correct position. If this happens, the mat will have to be raised again and swung back into the correct position.)

T. Repeat procedures of traveling forward on mats and moving mats forward until crane is in working position

U. Pick up one mat from rear of crane and place it on one side; then pick up other mat from rear and place it on other side

(NOTE: These two mats will serve to support the outriggers.)

V. Extend and set outriggers

W. Proceed with work until completed, moving mats as necessary

X. When work is completed, retract outriggers and move to solid ground, using mats as necessary

Y. Load mats on flatbed truck

(NOTE: Spotter will unhook mats.)

Z. Lower boom and prepare crane for transporting

AA. Move to next job or return to base

CRANES AND ATTACHMENTS
UNIT VI

JOB SHEET #12--CHANGE LAGGING

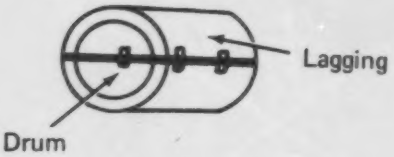
I. Equipment, materials, and personnel

- A. Cable crane
- B. Two half-sections of lagging
- C. Pickup truck with hitch
- D. Truck operator
- E. Tool kit
- F. Blocking
- G. Gloves

II. Procedure

(NOTE: Lagging is usually changed because a larger or smaller wire rope is to be used. The lagging [Figure 24] is molded in two half-sections to facilitate changing.)

FIGURE 24



A. Perform all starting procedures (Job Sheet #2)

B. Position crane in a fairly level location, leaving enough room behind unit to lower boom to near level and to empty drum of all cable

C. Lower boom until it rests on blocking in a near-level position

D. Release drum brake and disengage hoist clutch lever

(NOTE: Truck operator should back pickup to a position near point of boom and attach wire rope to pickup hitch.)

E. Move truck forward until all wire rope has been reeled off drum on which lagging is to be changed

JOB SHEET #12

F. Remove fastening bolts from lagging attached to drum

G. Lift one half-section of lagging from drum; then remove other half-section

H. Remove rust or any other foreign objects from drum

I. Install selected lagging on drum, one half-section at a time

J. Line up bolt holes, insert bolts, and tighten bolts until lagging is secure

K. Install cable, attaching dead end to drum in standard manner

L. Raise boom and proceed with work

CRANES AND ATTACHMENTS
UNIT VI

TEST

NAME ______________________________ SCORE ______________

1. Match terms associated with cranes and attachments to their correct definitions. Write the correct numbers in the blanks.

_____a. Having no "give" or slack; tight

_____b. Bucket attachment with hinged jaws

_____c. Horizontal distance measured from cab's rotation axis to a vertical line extending from outside edge of boom head sheave

_____d. Bucket attachment connected to crane by cable arrangement; used to excavate and clean

_____e. Grooved wrap-around plate on cable drum

_____f. Line from crane boom to clamshell bucket; holds bucket and keeps it from spinning out of position

_____g. Unit used primarily for lifting an object or load, transferring load to a new location by swinging or traveling, and then placing load in new location

_____h. Safety hook, bearing block, thrust bearing, brass bushing, and side weights

_____i. Accessories used to increase a machine's versatility and effectiveness

_____j. Outward extensions of frame supported by a jack or block; used to make equipment more stable

_____k. Tooth or set of teeth designed to lock against a ratchet

_____l. Heavy beam that is hinged at one end and has a weight-lifting device at other end

_____m. Threading or placing working lines

_____n. Fixed boom-support cable

1. Pawl (dog)
2. Boom
3. Hook block assembly
4. Lagging
5. Outriggers
6. Crane
7. Taut
8. Automatic tagline
9. Dragline
10. Clamshell
11. Attachments
12. Operating radius
13. Reeving
14. Pendant

TEST

_____o. Load being lifted

_____p. Dead or nonworking load attached to one end of machine to balance weight carried on opposite end

_____q. Overhead structure that supports machines or operating parts

_____r. End of cable that attaches to drum

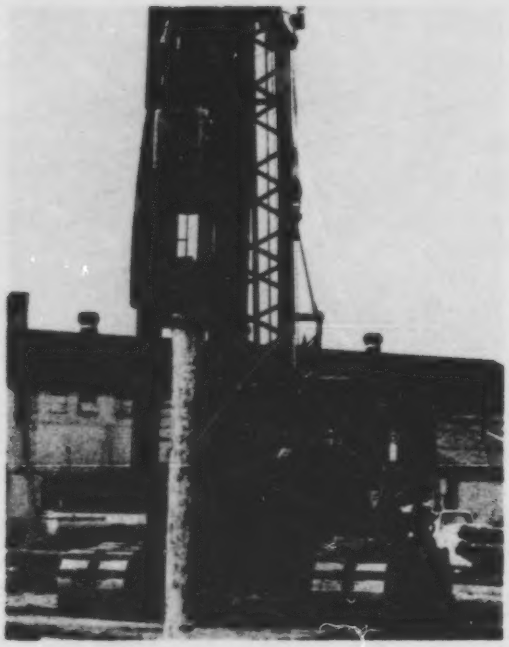
_____s. To move by throwing

_____t. Braces

_____u. Grooved wheel used to support wire rope or change its direction of travel

15. Dead end
16. Cast
17. Counterweight
18. Back stays
19. Gantry
20. Sheave
21. Live load

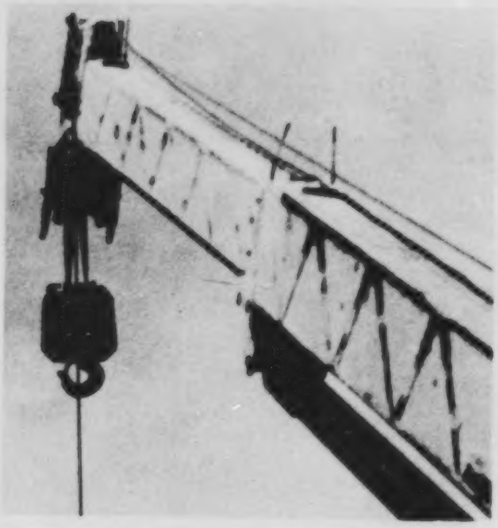
2. Label crane accessories and/or attachments used in highway maintenance. Write the correct names in the blanks provided under the pictures.



Used to drive posts or beams into the ground

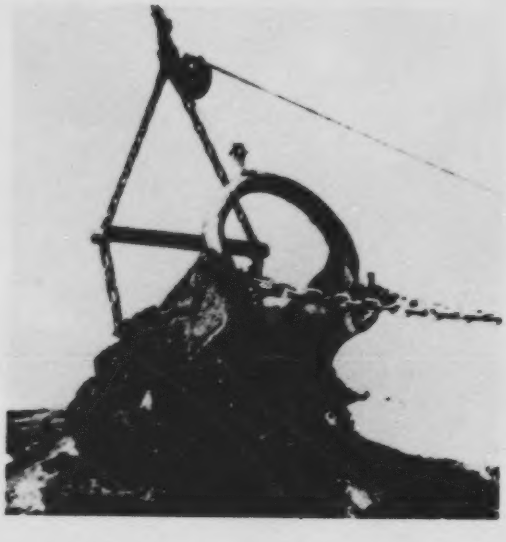
a. ____

TEST



Used to lift and relocate objects such as sign trusses and equipment

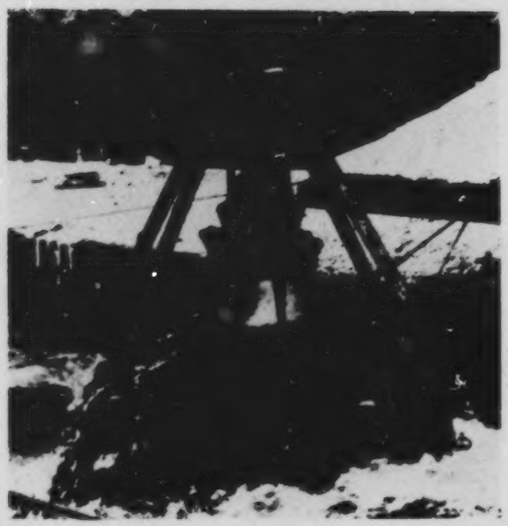
b. ______________________________



Used to clear channels and clean ditches

c. ______________________________

TEST



Used to stockpile materials

d. ______________________________

TEST

3. Identify parts of a truck cable crane. Write the correct numbers in the blanks.

_____a. Tagline winder

_____b. Outriggers

_____c. Operator's cab

_____d. Hoist cable

_____e. Superstructure

_____f. Hook block

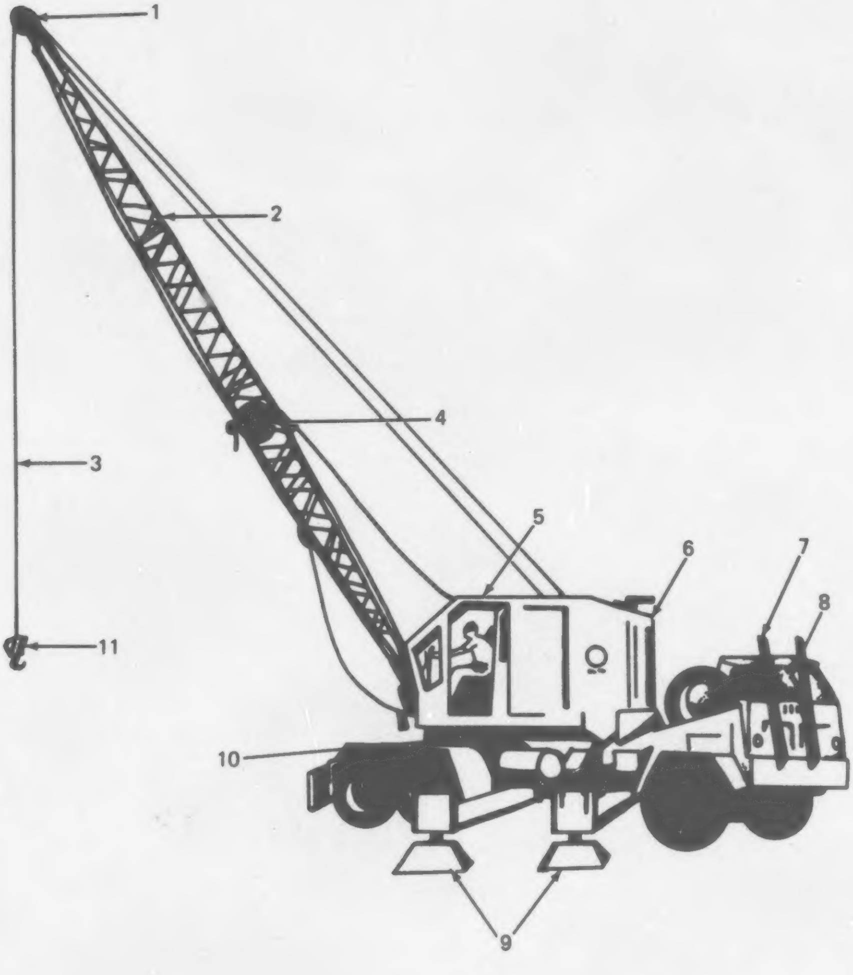
_____g. Driver's cab

_____h. Boom point sheave

_____i. Boom carriage

_____j. Turntable

_____k. Boom



TEST

4. Match cab controls on a typical crane to their correct functions. Write the correct numbers in the blanks.

_____a. Used to brake left-hand hoist drum

_____b. Used to trip the shovel dipper

_____c. Used to engage and disengage master clutch

_____d. Operates drag drum on a dragline and closing drum on a clamshell

_____e. Used in conjunction with boom-hoist lever to lower loads under power

_____f. Used for hoisting the load by controlling left hoisting drum

_____g. Raises and lowers crane boom

_____h. Used in conjunction with boom-hoist lever to crowd and retract shovel dipper

_____i. Used to swing crane in desired direction

_____j. Used to lock revolving frame in position and prevent it from turning on its base

_____k. Used to control engine speed

_____l. Used in conjunction with boom-hoist lever to raise and lower crane, dragline, clamshell, or piledriver boom

_____m. Used to brake right-hand hoist drum

1. Boom hoist
2. Throttle lever
3. Right hoist brake pedal
4. Left hoist brake pedal
5. Master clutch lever
6. Right hoist-drum lever
7. Power-down clutch lever
8. Boom-hoist clutch lever
9. Left hoist-drum lever
10. Swing clutch lever
11. Crowd-and-retract clutch lever
12. Swing-lock lever
13. Dipper trip lever

5. State seven general safety rules for operating equipment.

a. ____

b. ____

c. ____

d. ____

e. ____

f. ____

g. ____

TEST

6. State six safety factors for setting up a crane.

a. ____________________

b. ____________________

c. ____________________

d. ____________________

e. ____________________

f. ____________________

7. Select from the following list equipment-handling hazards or conditions that lead to hazards. Write an "X"in the blank before each correct answer.

_____a. Dropping or slipping of load

_____b. Failure to use outriggers

_____c. Operating with bent or damaged boom

_____d. Job exceeding safe boom radius

_____e. Failure to engage swing brake

_____f. Breaking cables

_____g. Job exceeding capacity of crane

_____h. Clutch or brake slippage increasing boom radius

_____i. Failure to use safety-type hooks

_____j. Faulty or poorly adjusted brakes and clutches

8. Select from the following list information the operator needs to determine equipment capabilities. Write an "X" in blank before each correct answer.

_____a. Type of footing

_____b. Boom types

_____c. Position of outriggers

_____d. Type of material being lifted

_____e. Method of determining amount of counterweight

_____f. Boom angles

_____g. Load ratings for main boom at all stated radii

_____h. Size of wire rope

TEST

______i. Crane model number, serial number, and date of manufacture

______j. Size of hook block

______k. Boom lengths

______l. Boom extension

______m. Work areas for which capacities are listed in chart

9. Select from the following list procedures for effective crane operation. Write an "X" in the blank before each correct answer.

______a. Use additional counterweight or tie-down devices to increase stability

______b. Be sure footing is adequate

______c. Use adequate lengths of hoist line to assure that block will travel to lowest point required

______d. Use taglines on bulky loads to avoid excessive swinging of load

______e. Raise boom before raising hook block

______f. Adjust engine fans as needed during operation

______g. Organize work for minimum travel time

______h. Position crane for shortest possible swing where repetitive lifting is involved

______i. Do not use power-down device to increase stability

______j. Lift load with boom in highest position possible

______k. Raise hook block before raising boom

______l. Do not use excessive counterweight or tie-down devices to increase stability

______m. Level footing to avoid swinging uphill or downhill

______n. Use power-down device, if available, when precise load handling is required

______o. Perform inspection and maintenance when convenient

TEST

10. Arrange in order procedures for hoisting a load. Write "1" in the blank before the first procedure, a "2" before the second procedure, and so on.

_____a. Swing crane with load

_____b. Attach load

_____c. Position boom

_____d. Spot load

_____e. Detach hook

_____f. Hoist load

_____g. Lower load

11. State six principles of hoisting.

a. ____

____

b. ____

____

c. ____

____

d. ____

____

e. ____

____

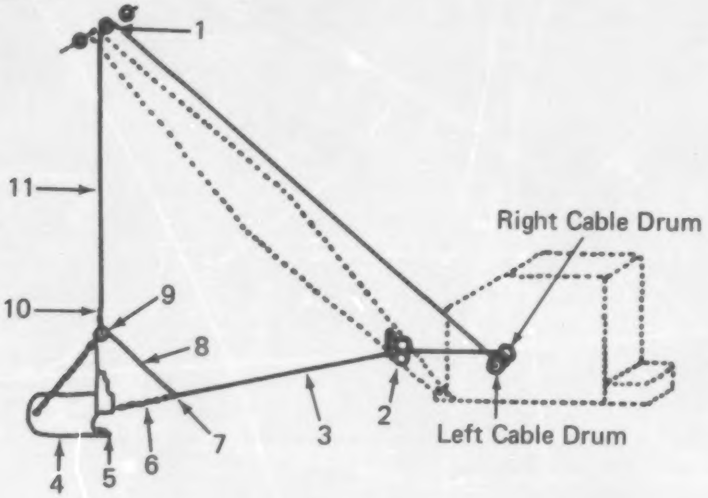
f. ____

____

TEST

12. Identify parts of a typical dragline system. Write the correct numbers in the blanks.

_____a. Fairlead
_____b. Bucket dump cable
_____c. Dragline bucket
_____d. Hoist cable
_____e. Bucket tooth
_____f. Dump sheave
_____g. Center-boom point sheave
_____h. Three-way socket
_____i. Hoist-cable socket
_____j. Drag chain (2)
_____k. Drag cable



13. Select from the following list procedures for effective dragline operation. Write an "X" in the blank before each correct answer.

_____a. Use a side cast whenever possible
_____b. Keep work area sloped upward toward machine
_____c. Never guide bucket by swinging superstructure while digging
_____d. Increase speed of swing on lighter load
_____e. Excavate in layers, not in trenches
_____f. Disregard overhead wires on cloudy days
_____g. Do not drag bucket in so close to machine that it will build up piles and ridges of material in front of machine
_____h. Use heavy timber mats for work on soft ground
_____i. Position machine to eliminate unnecessary casting and hoisting

TEST

_____j. Use outriggers only when necessary

_____k. When positioning dragline, allow access for maintenance, operating personnel, and hauling equipment

_____l. Position machine so front end tilts downward toward dragline

_____m. Salvage used pieces of hoist and drag rope to use as dump rope

14. Identify parts of a typical clamshell system. Write the correct numbers in the blanks.

_____a. Tagline cable

_____b. Right-boom point sheave

_____c. Dead-end socket

_____d. Sheave

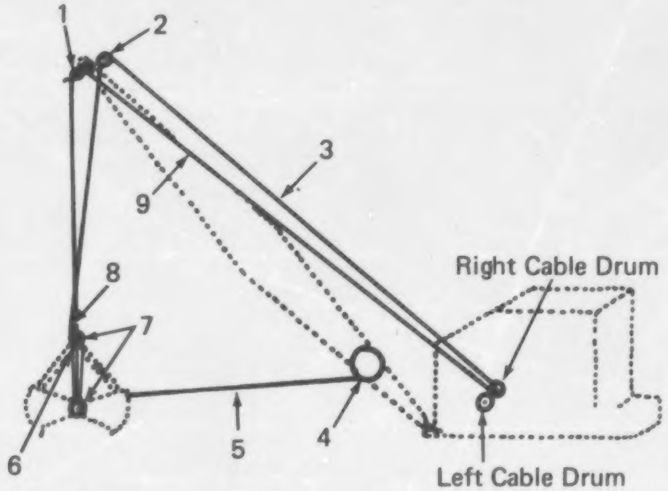
_____e. Holding cable

_____f. Left-boom point sheave

_____g. Closing cable

_____h. Tagline winder

_____i. Cable guide roller



15. Select from the following list procedures for effective clamshell operation. Write an "X" in the blank before each correct answer.

_____a. Position unit so that clamming or digging operation is at same radius as dumping operation

_____b. Lift with clamshell line

_____c. Select correct bucket size for machine

_____d. Position unit on level ground when possible

_____e. Position unit broadside to wind if possible

_____f. Position unit into wind if possible

TEST

(NOTE: Test question 16 lists the job sheets. They are an important part of this test. If they have not been completed, check with your instructor.)

16. Demonstrate the ability to

    a. Perform prestart inspection and maintenance procedures on a truck-mounted cable crane.

    b. Service a crane.

    c. Start, warm up, operate, and shut down a crane.

    d. Extend outriggers.

    e. Spot crane, lift, swing, and lower load.

    f. Replace wire rope.

    g. Perform a basic job using dragline.

    h. Reeve a clamshell.

    i. Perform an intermediate job using clamshell.

    j. Secure clamshell for travel and parking.

    k. Perform dragline operations on unstable soil.

    l. Change lagging.

CRANES AND ATTACHMENTS
UNIT VI

ANSWERS TO TEST

1. a. 7
   b. 10
   c. 12
   d. 9
   e. 4
   f. 8
   g. 6
   h. 3
   i. 11
   j. 5
   k. 1
   l. 2
   m. 13
   n. 14
   o. 21
   p. 17
   q. 19
   r. 15
   s. 16
   t. 18
   u. 20

2. a. Pile driver
   b. Crane hook
   c. Dragline
   d. Clamshell

3. a. 4
   b. 9
   c. 5
   d. 3
   e. 6
   f. 11
   g. 8
   h. 1
   i. 7
   j. 10
   k. 2

4. a. 4
   b. 13
   c. 5
   d. 6
   e. 7
   f. 9
   g. 1
   h. 11
   i. 10
   j. 12
   k. 2
   l. 8
   m. 3

ANSWERS TO TEST

5. Answer should include any seven of the following
   - a. Read operator's manual thoroughly: know your machine
   - b. Wear safety items required by job conditions
   - c. Know and observe hand signals
   - d. Be sure all safety guards and covers are secure and in place
   - e. Do not operate machine until you are sure area is clear of personnel and obstructions
   - f. Check all safety devices before moving machine
   - g. Do not jump on or off machine
   - h. Mount and dismount properly, using handholds and steps
   - i. Do not allow anyone to ride on machine
   - j. Know traffic pattern of job and obey spotter
   - k. Always park on level ground if possible
   - l. Do not leave engine running unattended
   - m. Avoid operating too close to banks or overhangs
   - n. Stay clear of raised machine parts

6. Answer should include any six of the following
   - a. Operate equipment safely to protect yourself, the public, all personnel, and property from injury or damage
   - b. Consider job site accessibility and safeness
   - c. Determine whether equipment will have to travel over ditches where pipe may be damaged
   - d. Allow sufficient room for erection and maneuverability
   - e. Ensure ample storage room for booms and components without interfering with maneuvers
   - f. Know the crane's maximum operating radius

ANSWERS TO TEST

g. Determine that operating location is level and solid

h. Know what excavations, slopes, trenches, or embankments are near the location

i. Make sure that you have a clear view of other equipment

j. Know location of power lines within work area

k. Store crane with boom lowered

7. a, b, c, d, f, g, h, i, j

8. b, f, g, i, k, m

9. b, c, d, g, h, j, k, l, m, n

10. a. 4
    b. 2
    c. 1
    d. 5
    e. 7
    f. 3
    g. 6

11. Answer should include any six of the following

    a. Load must be well secured and properly balanced in sling or lifting device before it is lifted more than a few inches

    b. All rigging equipment must be of sufficient size and in good condition

    c. Multiple-part lines should not be twisted around each other

    d. Wire rope must be properly seated in sheaves, tightly spooled, and seated on drum before a load or bucket is moved

    e. Hoist line must never be used to wrap load in place of a sling or chain

    f. Hoist line must be vertical before starting to lift

    g. Never lower load or boom past point where two full wraps of wire rope remain on drums

    h. Check capacity and wire rope length each time rope or boom length is changed

    i. In tight areas, make a "dry run" with a spotter

    j. Use a minimum of a three-point hitch to prevent a top-heavy load from rolling or tipping

ANSWERS TO TEST

k. To determine total weight, add weight of hook block, slings, and all material-handling devices to weight being lifted

l. Establish capacity, weight, and working radii and stay within those limits

12. a. 2
    b. 8
    c. 4
    d. 11
    e. 5
    f. 9
    g. 1
    h. 7
    i. 10
    j. 6
    k. 3

13. b, c, e, g, h, i, k, m

14. a. 5
    b. 2
    c. 8
    d. 7
    e. 9
    f. 1
    g. 3
    h. 4
    i. 6

15. a, c, d

16. Performance skills evaluated to the satisfaction of the instructor

CHERRY PICKER (AERIAL BUCKET TRUCK)
UNIT VII

UNIT OBJECTIVE

After completing this unit, the student should be able to operate controls on a cherry picker to complete specific jobs safely. This knowledge will be shown by completing job sheets and unit test with a minimum score of 85 percent.

SPECIFIC OBJECTIVES

After completing this unit, the student should be able to

1. Match terms associated with cherry pickers to their correct definitions.
2. List uses of cherry pickers in highway maintenance.
3. Identify the parts of a typical cherry picker (aerial bucket truck).
4. Identify controls on a typical cherry picker.
5. Match cherry picker controls to their correct functions.
6. Select from a list safety devices found on cherry pickers.
7. State safety rules for operating cherry pickers.
8. Select from a list suggestions for effective cherry picker operation:
9. Match soil conditions to correct digging procedures.
10. Demonstrate the ability to
    a. Perform prestart inspection and maintenance procedures on a cherry picker.
    b. Service a cherry picker.
    c. Set up unit.
    d. Secure cherry picker for travel.
    e. Repair or replace an overhead or high roadside sign.

CHERRY PICKER (AERIAL BUCKET TRUCK)
UNIT VII

SUGGESTED ACTIVITIES

I. Suggested activities

   A. Provide students with objective sheet.

   B. Provide students with information and job sheets.

   C. Discuss unit and specific objectives.

   D. Discuss information sheet.

   E. Demonstrate and discuss procedures outlined in job sheets.

   F. Provide alternate jobs if job sheets are not practical.

   G. Obtain operator's guides and service guides for particular machines being used for training.

   H. Arrange a field trip for students to observe cherry picker operation.

   I. Have students practice using controls until they become proficient.

   J. Stress to students that controls may vary with different models and manufacturers.

   K. Identify safety devices on the equipment and explain how they are used.

   L. Stress to students the importance of safety devices and safety practices when operating equipment.

   M. Review hand signals.

   (NOTE: Hand signal transparencies can be found in Unit XVII, "Rigging.")

   N. Give test.

II. Instructional materials

   A. Objective sheet

   B. Suggested activities

   C. Information sheet

   D. Job sheets

      1. Job Sheet #1--Perform Prestart Inspection and Maintenance Procedures on a Cherry Picker

SUGGESTED ACTIVITIES

2. Job Sheet #2--Service a Cherry Picker
3. Job Sheet #3--Set Up Unit
4. Job Sheet #4--Secure Cherry Picker for Travel
5. Job Sheet #5--Repair or Replace an Overhead or High Roadside Sign

E. Test

F. Answers to test

III. Unit references

A. Crane Inspection and Certification Bureau. *Aerial Lifts.* Orlando, Florida: SGS Control Services, Inc., n.d.

B. *Hi-Ranger, Form No. 1-74, 4-5.* Fort Wayne, Indiana: Mobile Aerial Towers, Inc., n.d.

C. *HI-RANGER Operation and Maintenance Manual.* Fort Wayne, Indiana: Mobile Aerial Towers, Inc., 1976.

D. *Operators-Owners Manual, Pitman "1100" Series Polecat®* Hydraulic Digger-Derrick. Grandview, Missouri: Pitman Division, A.B. Chance Co., 1979.

CHERRY PICKER (AERIAL BUCKET TRUCK)
UNIT VII

INFORMATION SHEET

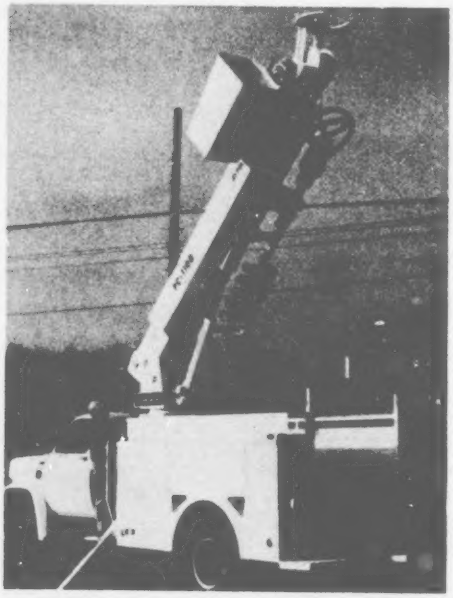
I. Terms and definitions

A. Cherry picker--An aerial device and related equipment (Figure 1)

(NOTE: A cherry picker may include a winch, auger, bucket, or a pole claw.)

EXAMPLE:

FIGURE 1



Courtesy of Pitman Division, Grandview, Missouri.

B. Bucket--Any personnel-carrying device--basket, platform, or bucket-- used as a component of an aerial device

C. Aerial device--Any vehicle-mounted device--telescoping, articulating, or both--used to position personnel

D. Interlock--Safety device used to ensure movement in proper sequence

E. Outriggers--Projecting beams or feet used to give stability to equipment by widening its base

F. Power takeoff (PTO)--Supplementary mechanism that allows engine power to be used to operate auxiliary equipment

INFORMATION SHEET

G. Auger--Rotating drill having a screw thread that carries material away from its face

(NOTE: On a cherry picker, the auger is used for digging operations.)

H. Winch--Drum that can be rotated to exert a strong pull while winding in a line; small hoist

I. Trunnion--Bar that rotates or tilts another part

J. Truss--Overhead support for signs extending across highway

II. Uses of cherry pickers in highway maintenance

(NOTE: A cherry picker, high lift, or aerial lift is used to lift personnel to work in high places. Some are equipped with a cable to lift objects, and some have auger attachments for digging. A cherry picker can maneuver into places where large rigs do not have space to operate.)

A. Working on traffic control signals

EXAMPLES: Signals, signs, streetlights, flashing lights, sign trusses

B. Lifting objects

EXAMPLES: Signal posts, sign trusses, sign uprights

C. Setting posts

EXAMPLES: Signal posts, large signposts

D. Digging signpost and guard-post holes

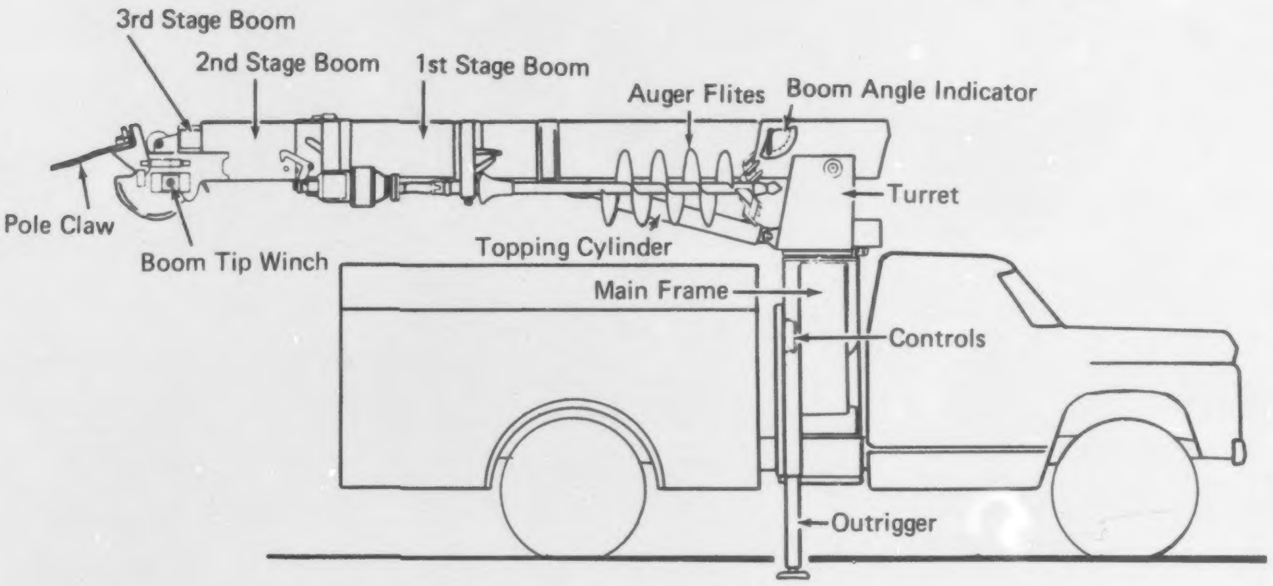
(NOTE: Augers can cut small 6- to 9-inch holes or holes up to 36 inches.)

INFORMATION SHEET

III. Parts of a typical cherry picker (aerial bucket truck) (Figure 2; Job Sheets #1 and #2)

(NOTE: The boom may be mounted in the center, on the corner, or on the rear. The winch may be located either on the boom end or on the turret. The example below is a centermount with a boom-end winch.)

FIGURE 2



3rd Stage Boom
2nd Stage Boom
1st Stage Boom
Auger Flites
Boom Angle Indicator
Turret
Pole Claw
Boom Tip Winch
Topping Cylinder
Main Frame
Controls
Outrigger

Used with permission of Pitman Division, Grandview, Missouri.

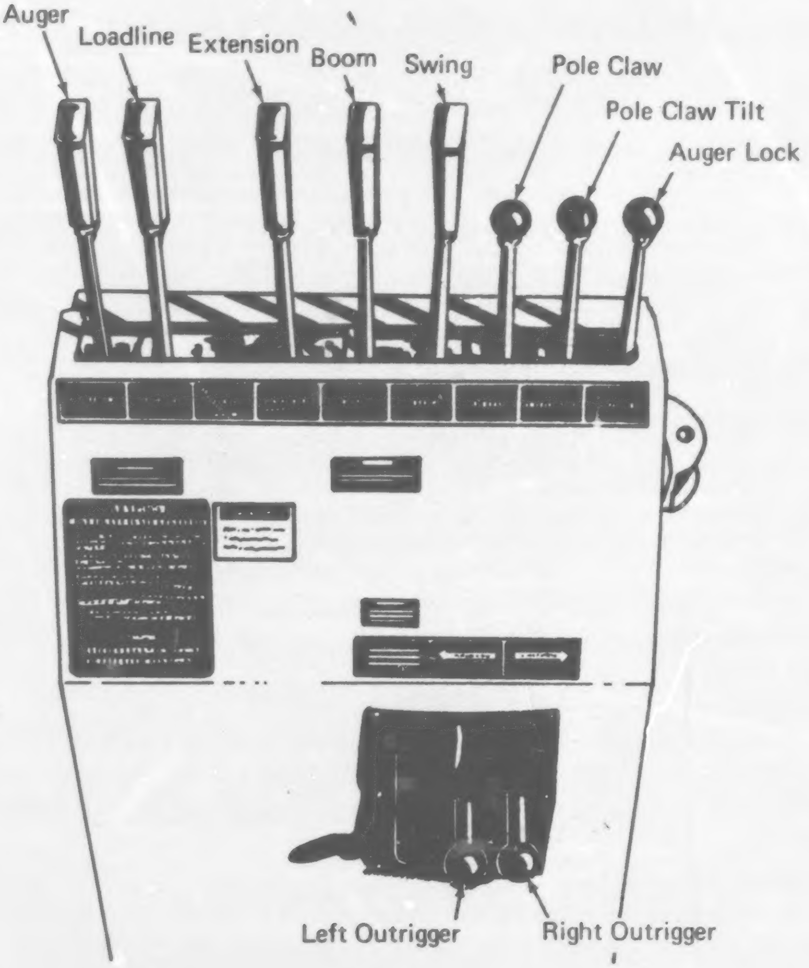
INFORMATION SHEET

IV. Controls on a typical cherry picker (Figures 3 and 4)

(NOTE: Controls will vary with model and manufacturer. Also, location and arrangement will vary with center-mounted, corner-mounted, and rear-mounted booms. Cherry pickers have two sets of controls. One set, the unit controls, can be reached from the ground; the other set, the remote controls, can be operated from the bucket. Unit controls override bucket controls, thus allowing emergency operations.)

A. Unit controls--Operated from the truck body

FIGURE 3


Auger
Loadline
Extension
Boom
Swing
Pole Claw
Pole Claw Tilt
Auger Lock
Left Outrigger
Right Outrigger

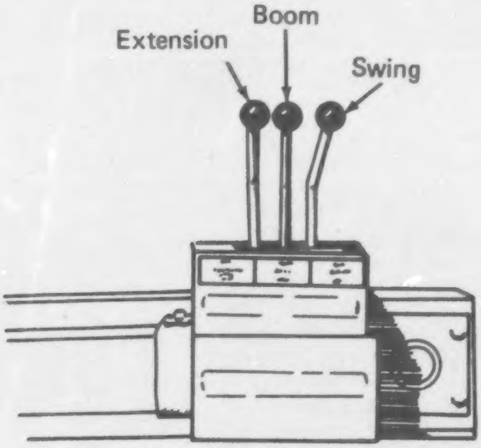
Used with permission of Pitman Division, Grandview, Missouri.

INFORMATION SHEET

B. Remote controls--Operated from the bucket

(NOTE: Some models are equipped with optional controls to operate accessories.)

FIGURE 4



Adapted with permission of Pitman Division, Grandview, Missouri.

V. Cherry picker controls and their functions (Job Sheets #3 and #4)

A. Swing--Moves boom clockwise or counterclockwise

EXAMPLES: Move lever to right to pivot boom clockwise; move to left to pivot boom counterclockwise.

B. Boom--Raises or lowers boom

C. Extension--Extends or retracts boom

D. Outrigger--Lowers or raises outrigger legs

E. Loadline--Plays out or reels in loadline on winch

F. Auger lock--Secures auger to boom when stowed; releases auger for operation

(NOTE: Before stowing auger, always operate the lever to LOCK and hold in this position until you hear relief valve operate.)

G. Auger--Operates auger in DIG or CLEAN position

EXAMPLES: Push forward to DIG--auger turns clockwise; pull backward to CLEAN--auger turns counterclockwise.

INFORMATION SHEET

- H. Pole claw--Opens or closes claws
- I. Pole claw tilt--Moves pole claw up or down
- J. Foot throttle (not shown)--Increases truck engine speed

  (NOTE: When the throttle is released, engine will return to idle speed.)
- K. Auger digging gears (not shown)--Select high or low auger speed

VI. Safety devices found on cherry pickers

- A. Safety interlock trigger
- B. Ground control palm button
- C. Outrigger boom interlock system
- D. Boom UP warning light
- E. Upper boom hold down
- F. Lower boom lock
- G. Outrigger sag light
- H. Outrigger warning buzzer
- I. Beacon lights
- J. Mobile unit backup buzzer
- K. Turn signals
- L. Safety harness for operator

VII. Safety rules for operating cherry pickers

- A. Read operator's manual thoroughly: know your machine
- B. Place warning signs when working in traffic
- C. Make sure that total load to be lifted does not exceed rated capacity of boom
- D. Make sure that no loose equipment or material can fall from bucket
- E. Clear all personnel from operating area
- F. Inspect equipment regularly
- G. Set outriggers and engage safety interlocks before lifting

INFORMATION SHEET

H. Check all safety devices before lifting

I. Allow only authorized persons to operate aerial lifts

J. Never lift objects with cable while person is in basket

K. Never sit on floor or edge of basket

L. Never move truck while boom is elevated in working position with persons in basket

M. Never alter insulated portion of aerial lift

N. Always cradle boom properly and stow outriggers before traveling

O. Always wear a safety belt when working from an aerial lift bucket

P. Be familiar with and follow signals given by spotter

Q. Block wheels when operating on an incline

R. Avoid maximum outward reach position on downhill side when unit is located on a sloping surface

VIII. Suggestions for effective cherry picker operation (Job Sheets #4 and #5)

(NOTE: The following are constructive suggestions for improving operating efficiency.)

A. Perform prestart inspection and maintenance

B. Position crane for shortest possible swing when repeated lifting is involved

C. Be sure equipment is on firm, level ground before operating lift

(NOTE: If working on a hillside or sloping terrain, try to position the vehicle so that the boom can be worked to the upside position. When working in a ditch, head truck in, or back in, positioning vehicle at right angle to ditch.)

D. Understand capabilities of equipment before performing job

E. Before rotating booms, make sure that they are raised high enough to clear obstructions

F. Avoid jerky operations; handle controls smoothly

G. Never hold a control actuated after function has reached the end of its travel

INFORMATION SHEET

H. Locate equipment to avoid possible contact with overhead obstructions

(CAUTION: Do not operate within 10 feet of power lines.)

(NOTE: The boom does not have to come in direct contact with wires to act as a conductor. If operating near power lines, power to lines should be shut off, or lines should be insulated.)

I. Avoid unnecessary booming up and down and telescoping

IX. Soil conditions and their correct digging procedures

A. Rocky soil--Operate auger at very low speed

(NOTE: Surface rocks large enough to deflect the auger should be removed by hand.)

B. Wet soil--Auger may have a tendency to screw into the ground; reduce auger feed pressure

(NOTE: Reducing auger feed pressure will fully pulverize soil and cut it loose. Rotate auger slowly while raising it to ease it out. Do not apply excessive pressure to the auger in wet soil because the upper side of the hole may cave in.)

C. Sand or gravel--Operate slowly and smoothly to prevent holes from caving in

(NOTE: Unless the hole is very wet, the auger rotation should be stopped before the auger is raised. Raise auger cautiously to prevent spilling the load.)

D. Frozen soil--Operate auger slowly under heavy down pressure; make sure blades are sharp

(NOTE: Rotation and digging pressure must be carefully controlled to keep the blade cutting at all times. If the blade rotates without cutting, it will dull quickly.)

CHERRY PICKER (AERIAL BUCKET TRUCK)
UNIT VII

JOB SHEET #1--PERFORM PRESTART INSPECTION AND MAINTENANCE PROCEDURES ON A CHERRY PICKER

I. Equipment and materials

   A. Cherry picker (aerial bucket truck)

   B. Operator's manual

   C. Engine oil

   D. Engine coolant

   E. Hydraulic fluid

   F. Fuel

   G. Lubricants

   H. Grease gun

   I. Rags

II. Procedure

(NOTE: Deficiencies should be corrected immediately or reported to the proper authority. Do not operate defective equipment.)

   A. Make a walk-around inspection for leaks and broken, worn, or missing parts

   B. Check engine oil level; add or change engine oil if necessary

   C. Check engine coolant level; add coolant if needed

   D. Check hydraulic reservoir level; add fluid if needed

   E. Check fuel level; fill tank if necessary

   F. Check battery connections for tightness and corrosion

   G. Check battery electrolyte level; add water if needed

   H. Check air cleaner; remove and clean filter if necessary

   I. Check brakes

   J. Check tires

   K. Clean and lubricate all grease fittings according to operator's manual

JOB SHEET #1

L. Check hydraulic system for leaking lines and connections, bent or kinked lines, and lines rubbing against other parts

M. Check drive belts for tightness

N. Check electrical wire connections

O. Clean windshield and mirrors; adjust mirrors

P. Check gauges

Q. Check foot pedals for proper functioning

R. Check levers and controls for proper functioning

S. Remove trash

T. Check lights

U. Check safety devices

V. Check outrigger operation

W. Operate boom through two cycles to check operation and controls

X. Check personnel bucket for fractures

Y. Check booms; they should be clean and dry

CHERRY PICKER (AERIAL BUCKET TRUCK)
UNIT VII

JOB SHEET #2--SERVICE A CHERRY PICKER

I. Equipment and materials

A. Cherry picker

B. Operator's manual

C. Tool kit

D. Air supply

E. Grease gun

F. Lubricants

G. Cleaning solvents

H. Rags

I. Water

J. Engine coolant

K. Engine oil

L. Hydraulic fluid

M. Transmission fluid

N. Brake fluid

O. Tire pressure gauge

P. Fuel

II. Procedure

(NOTE: Follow departmental preventive maintenance program when servicing equipment. Refer to operator's manual for lubrication chart and for servicing specific components and attachments.)

A. Visually inspect for leaks and broken, worn, or missing parts

(NOTE: Major repairs and replacements should be reported to the proper authority and completed by a trained mechanic.)

B. Check engine oil level, filter, lines and hoses; add engine oil if needed

JOB SHEET #2

C. Check engine coolant level, radiator cap, hose, and radiator; add coolant if needed

(CAUTION: Do not remove radiator cap unless engine is cool; then, open cap slowly to release pressure.)

D. Clean air filter; replace if necessary

E. Check fuel level, fuel filters, and sediment bowl (where applicable); fill fuel tank if necessary

F. Check battery electrolyte level, battery cables, and connectors; add water or electrolyte if needed

(CAUTION: Keep sparks and fire away from battery.)

G. Check exhaust system for loose connections and holes

H. Check hydraulic fluid level, filters, hose, lines, and fittings; look for leaks; add fluid if needed

I. Check transmission fluid level; add fluid if needed

J. Check transmission pressure line filter and breather

K. Check brake adjustment and condition; adjust if necessary

L. Check brake master cylinder fluid level; fill with fluid if necessary

M. Check clutch adjustment; adjust if necessary

N. Check drive belts for tension and wear; adjust or replace if necessary

O. Check wiring, insulation, and connections

P. Clean and lubricate grease fittings according to operator's manual

Q. Check tire pressure; inflate to recommended pressure if necessary

R. Check condition of tires

S. Check all safety devices; repair if necessary

T. Check major components and/or accessories

1. Loadline cable and auger spool cable for wear, broken strands, or fraying; replace where necessary
2. Main frame and body mounting bolts for tightness
3. Boom pins

JOB SHEET #2

4. Relief valves
5. Winch-motor mounting bolts for tightness
6. Cable drums for cracks and wear
7. Cylinders for leaks, dents, and rust

CHERRY PICKER (AERIAL BUCKET TRUCK)
UNIT VII

JOB SHEET #3--SET UP UNIT

I. Equipment and materials

A. Aerial bucket truck

B. Operator's manual

C. Wood blocks (if operating on an incline)

II. Procedure

A. Position unit so that working area is within reach of boom

(NOTE: If positioning on a slope, position unit to avoid extending boom's maximum reach over the downhill side of truck.)

B. Set hand brake; block wheels if needed

C. With truck gearshift in neutral, engage clutch (if truck is equipped with a manual transmission) and engage PTO

D. Using the hand throttle, accelerate truck engine to proper operating speed

(NOTE: Check operator's manual for engine speeds.)

E. Bring hydraulic system up to operating temperature

(NOTE: When operating unit controls, return hand throttle to idle after warm-up, and use foot throttle on the main frame to control engine speed while operating the boom and bucket.)

F. Hold outrigger control valve in down position until all outriggers are in contact with ground and truck frame has been raised 2 or 3 inches

G. Engage safety interlocks

(NOTE: If unit is positioned on a slope, it will be necessary to use blocks under low-side outriggers.)

H. Check all controls for proper operation by operating each function through one complete cycle

I. Mount bucket

J. Depress trigger on control handle and push handle straight forward to elevate lower boom

JOB SHEET #3

K. Move control handle as needed to move bucket directly to working area

(NOTE: Always depress trigger before moving control handle; release trigger only when control handle has been returned to neutral.)

CHERRY PICKER (AERIAL BUCKET TRUCK)
UNIT VII

JOB SHEET #4--SECURE CHERRY PICKER FOR TRAVEL

I. Equipment--Cherry picker

II. Procedure

   A. Center boom accurately over saddle

      (CAUTION: Pressure will be put on turntable drive mechanism and may cause damage if boom is not accurately centered before lowering to saddle.)

   B. Lower boom into saddle

   C. Secure hold-down straps if machine is so equipped

      (CAUTION: To avoid damage to the boom, fiberglass upper booms must be completely seated and secured in the saddle before traveling.)

   D. Check auger lock

   E. Check that buckets are secured to truck

   F. Clean and stow all tools and equipment so that no loose objects are left in truck bed

   G. Raise outriggers and disengage PTO

   H. Remove wheel chocks and stow properly

CHERRY PICKER (AERIAL BUCKET TRUCK)
UNIT VII

JOB SHEET #5--REPAIR OR REPLACE AN OVERHEAD OR HIGH ROADSIDE SIGN

I. Equipment and materials

- A. Aerial bucket truck
- B. Wood blocks
- C. Wrenches and screwdrivers
- D. Small electric drill or hand brace
- E. Metal drill bits, assorted sizes
- F. Signboards and/or letters and numerals
- G. Nuts, washers, bolts, and screws
- H. Sign to be replaced or repaired
- I. Recommended safety equipment
  - 1. Hard hat
  - 2. Safety harness

II. Procedure

- A. Place required warning signs before placing unit in working position
- B. Position unit so that working area is within reach of boom
- C. Set hand brake
- D. Engage PTO
- E. Lower outriggers, making sure all are in contact with solid ground
- F. Raise truck frame 2 or 3 inches; make as level as possible

  (NOTE: If unit is positioned on a slope or on unstable ground, blocks must be used under the base of low-side outriggers or on the unstable ground.)
- G. Engage outrigger safety interlocks
- H. Get into bucket

JOB SHEET #5

I. Maneuver boom with bucket control handle until sign can be easily reached from bucket

(NOTE: Positioning of the bucket can also be done with ground controls.)

J. Use bucket controls as necessary to reposition

K. Attach safety harness

L. Complete repair or replacement of sign

M. Lower bucket and dismount

N. Secure boom for travel

O. Raise outriggers; secure in travel position

P. Disengage PTO

Q. Pick up wood blocks and warning signs

CHERRY PICKER (AERIAL BUCKET TRUCK)
UNIT VII

TEST

NAME ____________________ SCORE ____________

1. Match terms associated with cherry pickers to their correct definitions. Write the correct numbers in the blanks.

______a. An aerial device and related equipment

______b. Any personnel-carrying device--basket, platform, or bucket--used as a component of an aerial device

______c. Any vehicle-mounted device--telescoping, articulating, or both--used to position personnel

______d. Safety device used to ensure movement in proper sequence

______e. Projecting beams or feet used to give stability to equipment by widening its base

______f. Overhead support for signs extending across highway

______g. Supplementary mechanism that allows engine power to be used to operate auxiliary equipment

______h. Rotating drill having a screw thread that carries material away from its face

______i. Drum that can be rotated to exert a strong pull while winding in a line; small hoist

______j. Bar that rotates or tilts another part

1. Aerial device
2. Power takeoff (PTO)
3. Interlock
4. Cherry picker
5. Outriggers
6. Bucket
7. Winch
8. Truss
9. Trunnion
10. Auger

2. List three uses of cherry pickers in highway maintenance.

a. ______________________________

b. ______________________________

c. ______________________________

TEST

3. Identify parts of a typical cherry picker (aerial bucket truck). Write the correct numbers in the blanks.

______a. Topping cylinder

______b. Outrigger

______c. 3rd stage boom

______d. Auger flites

______e. Main frame

______f. Pole claw

______g. Boom tip winch

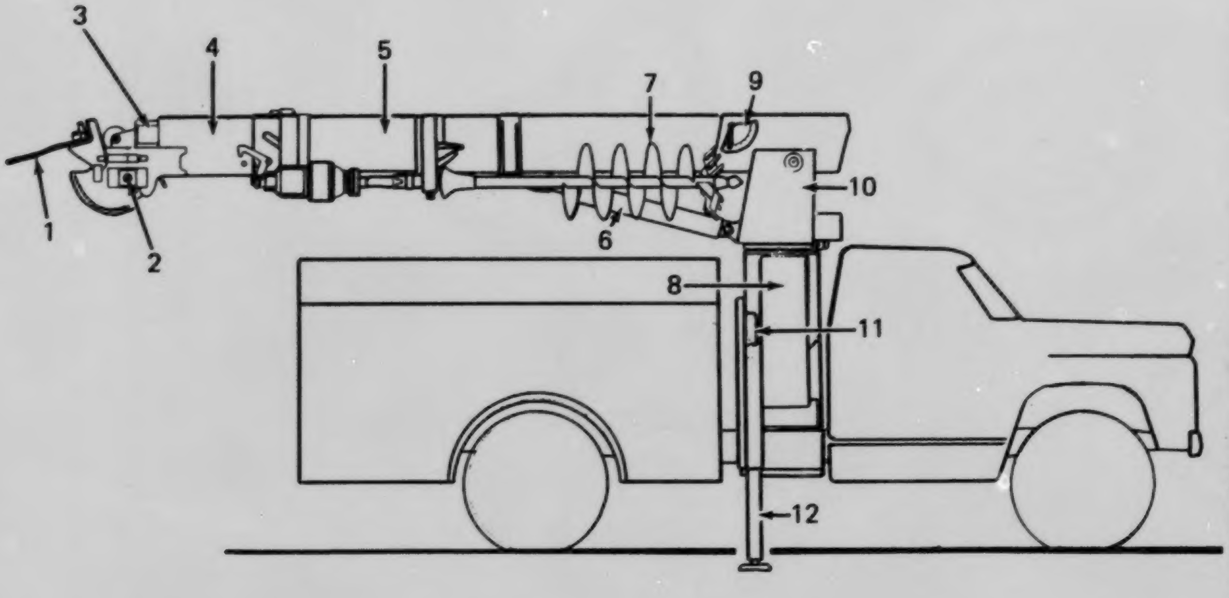
______h. Boom angle indicator

______i. Controls

______j. 1st stage boom

______k. Turret

______l. 2nd stage boom



TEST

4. Identify controls on a typical cherry picker. Write the correct numbers in the blanks. Test question continued on next page.

Unit controls

_____a. Pole claw tilt

_____b. Extension

_____c. Auger

_____d. Left outrigger

_____e. Swing

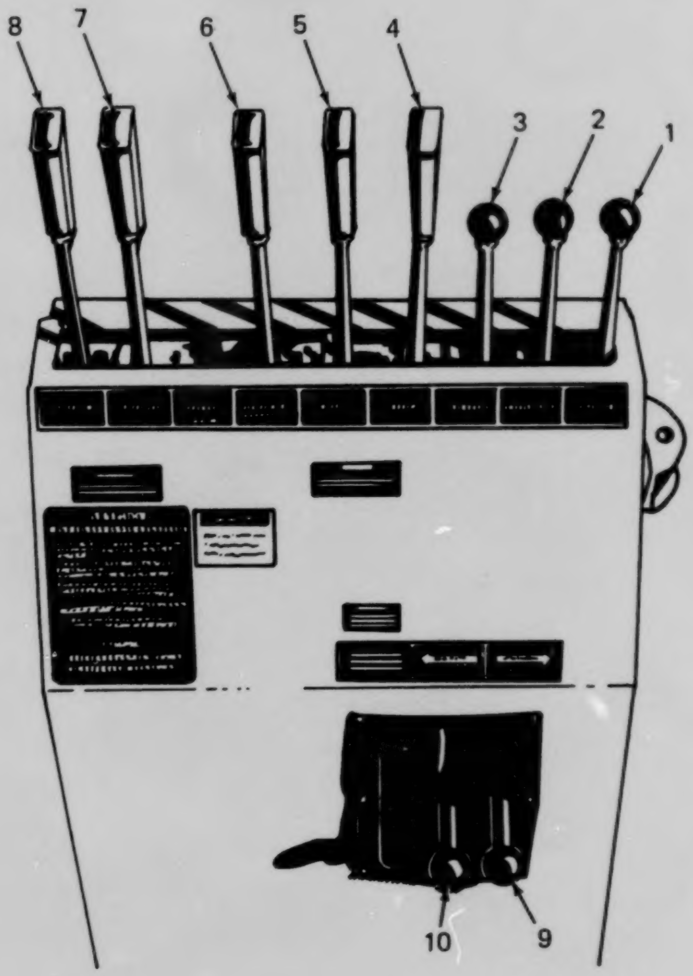
_____f. Right outrigger

_____g. Pole claw

_____h. Loadline

_____i. Boom

_____j. Auger lock



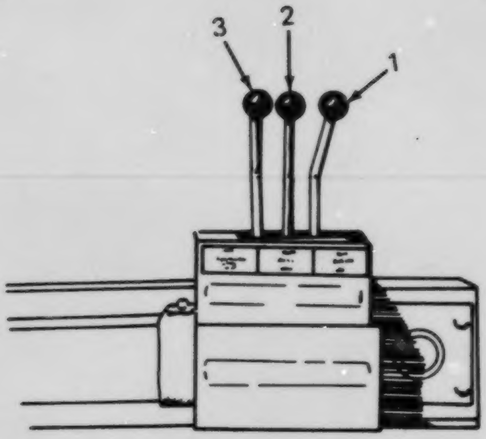
TEST

Remote controls

______k. Boom

______l. Swing

______m. Extension



5. Match cherry picker controls to their correct functions. Write the correct numbers in the blanks.

______a. Opens or closes claws

______b. Increases truck engine speed

______c. Secures auger to boom when stowed; releases auger for operation

______d. Raises or lowers boom

______e. Select high or low auger speed

______f. Extends or retracts boom

______g. Moves boom clockwise or counterclockwise

______h. Moves pole claw up or down

______i. Operates auger in DIG or CLEAN position

______j. Plays out or reels in loadline on winch

______k. Lowers or raises outrigger legs

1. Auger
2. Pole claw tilt
3. Outrigger
4. Loadline
5. Pole claw
6. Foot throttle
7. Swing
8. Extension
9. Boom
10. Auger lock
11. Auger digging gears

TEST

6. Select from the following list safety devices found on cherry pickers. Write an "X" in the blank before each correct answer.

_____a. Sealed beam lights

_____b. Upper boom hold down

_____c. Outrigger warning buzzer

_____d. Boom UP spotlights

_____e. Safety interlock trigger

_____f. Safety harness for operator

_____g. Mobile unit door locks

_____h. Mobile unit backup buzzer

_____i. Lower boom lock

7. State twelve safety rules for operating cherry pickers.

a. ____

____

b. ____

____

c. ____

____

d. ____

____

e. ____

____

f. ____

____

g. ____

____

TEST

h. ______________________________

____

i. ______________________________

____

j. ______________________________

____

k. ______________________________

____

l. ______________________________

____

8. Select from the following list suggestions for effective cherry picker operation. Write an "X" in the blank before each correct answer.

_____a. Rotate bucket before changing direction of lift

_____b. Locate equipment to avoid possible contact with overhead obstructions

_____c. Allow booms to "creep" to correct working position

_____d. Position crane for shortest possible swing when repeated lifting is involved

_____e. Avoid jerky operations; handle controls smoothly

_____f. Avoid using ground controls

_____g. Be sure equipment is on firm, level ground before operating lift

_____h. Avoid unnecessary booming up and down and telescoping

_____i. Locate equipment at right angles to slope when working on a hillside

_____j. Understand capabilities of equipment before performing job

_____k. Perform prestart inspection and maintenance

_____l. Drill holes in bucket for improved drainage

_____m. Never hold a control actuated after function has reached the end of its travel

TEST

_____n. Check that booms are raised high enough to clear obstructions after raising

_____o. Always rotate boom in clockwise direction

9. Match soil conditions to correct digging procedures. Write the correct numbers in the blanks.

_____a. Operate slowly and smoothly to prevent holes from caving in	1. Rocky soil
_____b. Operate auger at very low speed	2. Frozen soil
_____c. Operate auger slowly under heavy down pressure; make sure blades are sharp	3. Sand or gravel
_____d. Auger may have a tendency to screw into the ground; reduce auger feed pressure	4. Wet soil

(NOTE: Test question 10 lists the job sheets. They are an important part of this test. If they have not been completed, check with your instructor.)

10. Demonstrate the ability to

   a. Perform prestart inspection and maintenance procedures on a cherry picker.

   b. Service a cherry picker.

   c. Set up unit.

   d. Secure cherry picker for travel.

   e. Repair or replace an overhead or high roadside sign.

CHERRY PICKER (AERIAL BUCKET TRUCK)
UNIT VII

ANSWERS TO TEST

1. a. 4
   b. 6
   c. 1
   d. 3
   e. 5
   f. 8
   g. 2
   h. 10
   i. 7
   j. 9

2. Answer should include any three of the following
   a. Working on traffic control signals
   b. Lifting objects
   c. Setting posts
   d. Digging signpost and guard-post holes

3. a. 6
   b. 12
   c. 3
   d. 7
   e. 8
   f. 1
   g. 2
   h. 9
   i. 11
   j. 5
   k. 10
   l. 4

4. a. 2
   b. 6
   c. 8
   d. 10
   e. 4
   f. 9
   g. 3
   h. 7
   i. 5
   j. 1
   k. 2
   l. 1
   m. 3

ANSWERS TO TEST

5. a. 5
   b. 6
   c. 10
   d. 9
   e. 11
   f. 8
   g. 7
   h. 2
   i. 1
   j. 4
   k. 3

6. b, c, e, f, h, i

7. Answer should include any twelve of the following

   a. Read operator's manual thoroughly: know your machine
   b. Place warning signs when working in traffic
   c. Make sure that total load to be lifted does not exceed rated capacity of boom
   d. Make sure that no loose equipment or material can fall from bucket
   e. Clear all personnel from operating area
   f. Inspect equipment regularly
   g. Set outriggers and engage safety interlocks before lifting
   h. Check all safety devices before lifting
   i. Allow only authorized persons to operate aerial lifts
   j. Never lift objects with cable while person is in basket
   k. Never sit on floor or edge of basket
   l. Never move truck while boom is elevated in working position with persons in basket
   m. Never alter insulated portion of aerial lift
   n. Always cradle boom properly and stow outriggers before traveling
   o. Always wear a safety belt when working from an aerial lift bucket
   p. Be familiar with and follow signals given by spotter

ANSWERS TO TEST

q. Block wheels when operating on an incline

r. Avoid maximum outward reach position on downhill side when unit is located on a sloping surface

8. b, d, e, g, h, j, k, m

9. a. 3
   b. 1
   c. 2
   d. 4

10. Performance skills evaluated to the satisfaction of the instructor

SPREADER (SELF-PROPELLED)
UNIT VIII

UNIT OBJECTIVE

After completing this unit, the student should be able to perform safely and effectively the duties of each operator on a self-propelled spreader. This knowledge will be shown by completing job sheets and unit test with a minimum score of 85 percent.

SPECIFIC OBJECTIVES

After completing this unit, the student should be able to

1. Match terms associated with spreaders to their correct definitions.
2. Select from a list uses of a self-propelled spreader.
3. Identify the parts of a spreader.
4. Identify the controls on a typical self-propelled spreader.
5. State general safety rules for operating equipment.
6. State safety rules for operating a spreader.
7. Arrange in order stages of chip flow through a spreader.
8. Select from a list principles of spreader operation.
9. Distinguish among responsibilities of primary operator, conveyor belt operator, and truck guide operator.
10. State procedures for effective spreader operation.
11. Demonstrate the ability to
    a. Perform prestart inspection and maintenance procedures on a spreader.
    b. Service a spreader.
    c. Start, warm up, operate, and shut down a spreader.
    d. Remove hopper for transport.
    e. Operate controls on a chip seal operation.
    f. Control conveyor belts on a chip seal operation.
    g. Guide truck operator on a chip seal operation.
    h. Chip seal a roadway.

SPREADER (SELF-PROPELLED)
UNIT VIII

SUGGESTED ACTIVITIES

I. Suggested activities

  A. Order materials to supplement unit.

    1. *Shake Hands With Danger.* Color, 22 minutes, Calvin Communications, 1980. Available from Calvin Communications, P. O. Box 15607, Kansas City, Missouri 60106, 816/471-7800.

       (NOTE: This film stresses the importance of safety procedures that, if ignored or overlooked, will result in serious consequences. This is an excellent film to show equipment operators.)

    2. *Keeping Your Job Is Work.* Color, 12 minutes, Dibie-Dash, 1971. Available from Dibie-Dash Productions, Inc., 4949 Hollywood Blvd., Suite 208, Hollywood, California 90027.

       (NOTE: This film emphasizes the importance of meeting job responsibilities. It is very unique but simple, and it presents a series of job situations pointing out the responsibilities of an employee.)

  B. Provide students with objective sheet.

  C. Provide students with information and job sheets.

  D. Discuss unit and specific objectives.

  E. Discuss information sheet.

  F. Demonstrate and discuss procedures outlined in job sheets.

  G. Provide alternative jobs if those in the job sheets are not practical.

  H. Arrange a field trip for students to observe spreader operations.

  I. Discuss application of various sizes of chips.

  J. Stress the need for practicing operations, particularly steering, for good spreader operation.

  K. Allow students to practice on the spreader, and review procedures for each operator position.

     (NOTE: If it is possible to use experienced operators in the positions of primary operator and conveyor belt operator, allow the novice to guide the truck and become familiar with the spreader operation as a whole.)

SUGGESTED ACTIVITIES

L. Have students perform Job Sheets #5-#7 repeatedly, rotating students until each has mastered the duties of each of the three spreader operators.

M. Give test.

II. Instructional materials

A. Objective sheet

B. Suggested activities

C. Information sheet

D. Job sheets

1. Job Sheet #1--Perform Prestart Inspection and Maintenance Procedures on a Spreader
2. Job Sheet #2--Service a Spreader
3. Job Sheet #3--Start, Warm Up, Operate, and Shut Down a Spreader
4. Job Sheet #4--Remove Hopper for Transport
5. Job Sheet #5--Operate Controls on a Chip Seal Operation
6. Job Sheet #6--Control Conveyor Belts on a Chip Seal Operation
7. Job Sheet #7--Guide Truck Operator on a Chip Seal Operation
8. Job Sheet #8--Chip Seal a Roadway

E. Test

F. Answers to test

III. Unit references

A. *Chipspreader Operation, Maintenance and Safety Manual.* E. D. Etnyre & Co., 200 Jefferson Street, Oregon, Illinois 61061 (n.d.).

B. *Construction Manual for Highway Construction.* American Association of State Highway and Transportation Officials, 444 N. Capital St., N.W., Suite 225, Washington, D.C. 20001, 1980.

C. *Spreadmaster Model SPK-H Operation and Maintenance Manual.* Roscoe Manufacturing Company, 3118 Snelling Avenue, Minneapolis, Minnesota 55406, 1982.

SPREADER (SELF-PROPELLED)
UNIT VIII

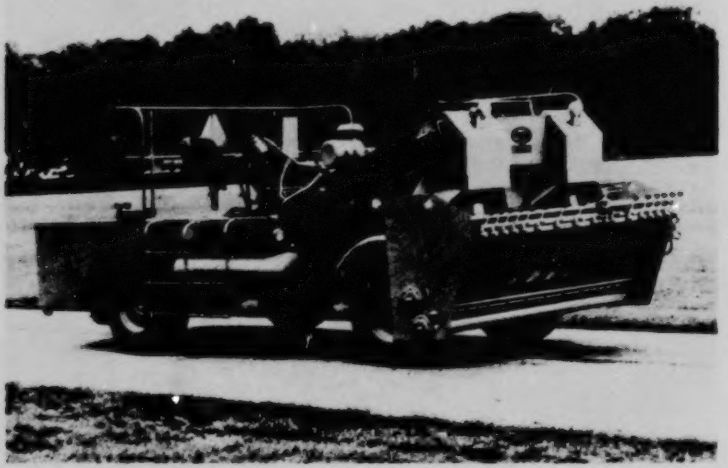
INFORMATION SHEET

I. Terms and definitions

A. Spreader--Machine that spreads chips behind an asphalt distributor (Figure 1)

EXAMPLE:

FIGURE 1



Courtesy of E.D. Etnyre & Company.

B. Chips (aggregate)–Crushed rock or gravel screened to sizes for use in road surfaces, concrete, or asphalt mixes

C. Blot--Soak up

D. Bleeding--Excess asphalt material that seeps through to the surface

E. Screenings--Dust and small particles from rocks

II. Uses of a self-propelled spreader

A. Penetration operations

B. Chip sealing or sand sealing roadways

C. Chip sealing or sand sealing shoulders

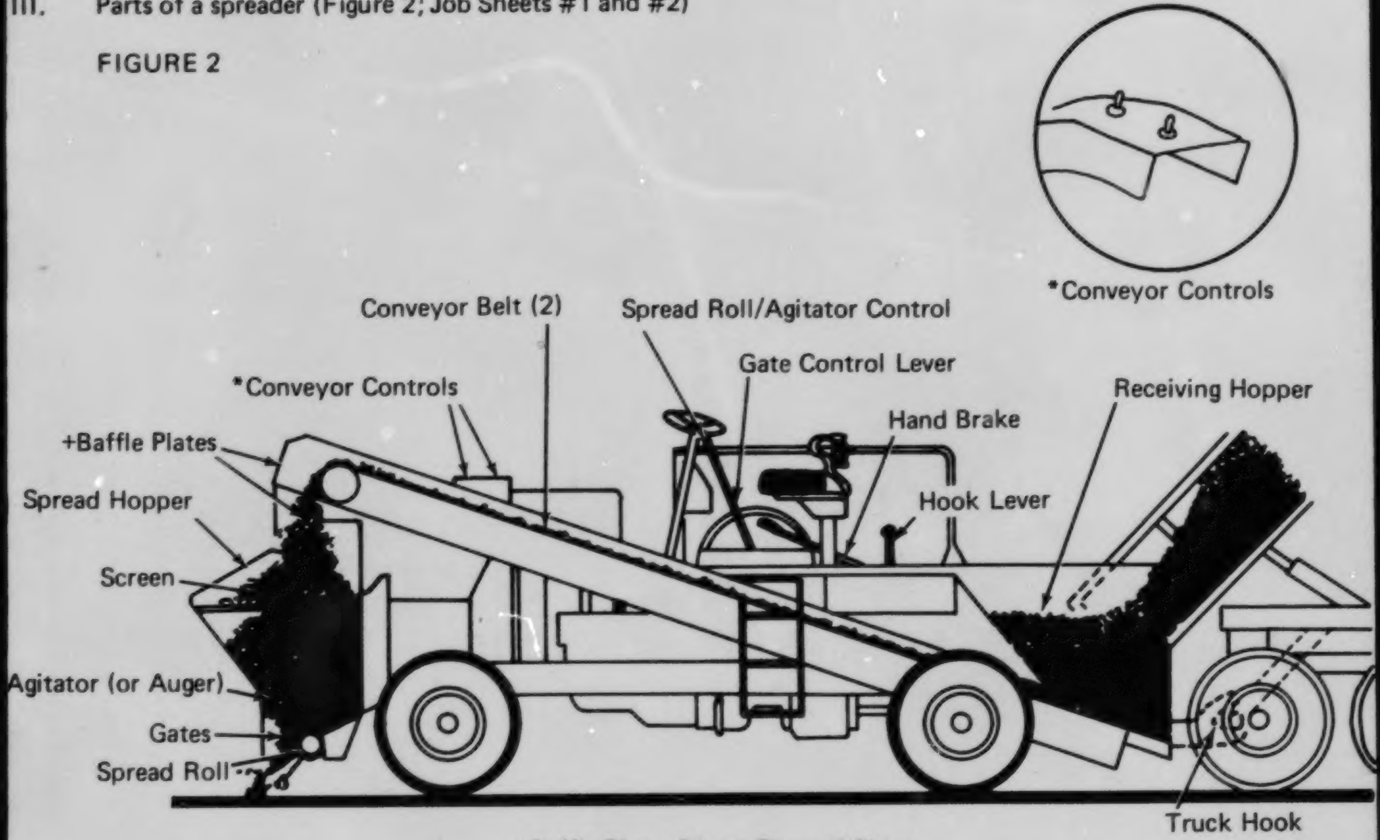
D. Laying large chip seal patches

E. Blotting bleeding

INFORMATION SHEET

III. Parts of a spreader (Figure 2; Job Sheets #1 and #2)

FIGURE 2


*Conveyor Controls
Conveyor Belt (2)
Spread Roll/Agitator Control
Gate Control Lever
*Conveyor Controls
Receiving Hopper
Hand Brake
+Baffle Plates
Hook Lever
Spread Hopper
Screen
Agitator (or Auger)
Gates
Spread Roll
Truck Hook

+Baffle Plates Direct Flow of Chips

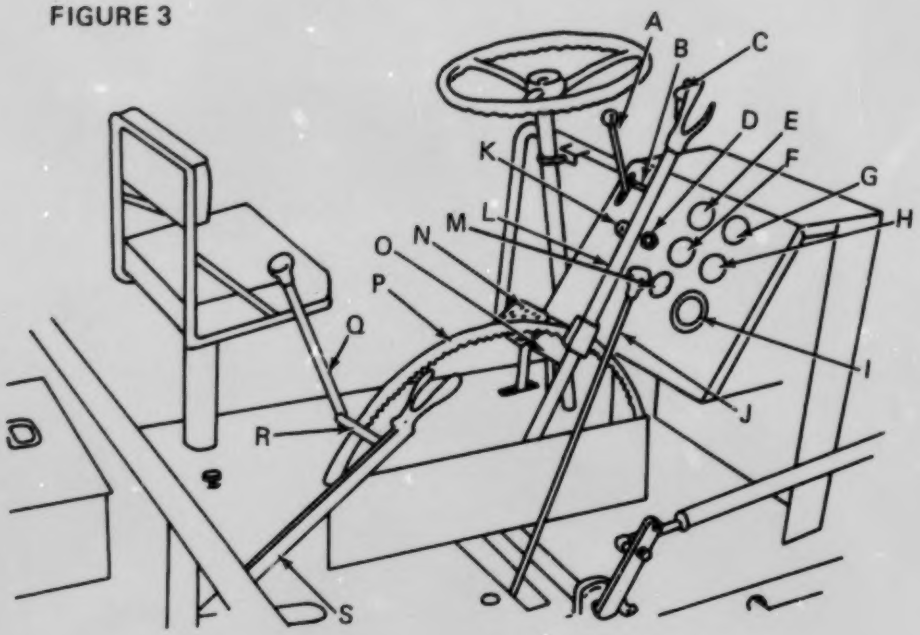
Used with permission of Rosco Manufacturing Co.

INFORMATION SHEET

IV. Controls on a typical self-propelled spreader (Figure 3; Job Sheet #3)

(NOTE: Some models have dual control switches or dual controls so that the spreader can be operated from the left or right side.)

FIGURE 3



Used with permission of Rosco Manufacturing Co.

A. Throttle

B. Choke

C. Agitator switch

D. Starter button

E. Water temperature gauge

F. Oil pressure gauge

G. Hydraulic oil temperature gauge

H. Ammeter

I. Hydraulic oil pressure gauge

J. Transmission control lever

K. Ignition switch

L. Gate control

M. Tachometer

N. Clutch

O. Brake

P. Forward/reverse lever

Q. Quadrant (opens and closes gate)

R. Pawl stop (sets gate opening at 1/16-inch intervals)

S. Hand brake

INFORMATION SHEET

V. General safety rules for operating equipment

- A. Read operator's manual thoroughly: know your machine
- B. Study departmental safety manual
- C. Wear safety items required by job conditions
- D. Know and observe hand signals
- E. Be sure all safety guards and covers are in place and secure
- F. Do not operate machine until you are sure personnel and obstructions are cleared from area
- G. Check all safety devices before moving machine
- H. Do not jump on or off machine
- I. Mount and dismount properly, using ladder and grab irons
- J. Do not allow anyone to ride on machine
- K. Know traffic pattern of job and obey spotter
- L. Always park on level ground if possible
- M. Do not leave engine running unattended
- N. Avoid operating too close to banks or overhangs
- O. Keep machine clean

VI. Safety rules for operating a spreader

- A. Use traffic control devices
- B. Stay clear of belts
- C. Watch for oncoming traffic
- D. Watch for obstructions

  EXAMPLES: Guardrails, bridge abutments, culverts, signposts
- E. Wear goggles and respirator in dusty conditions

VII. Stages of chip flow through a spreader

- A. Truck loads chips into rear receiving hopper
- B. Conveyor belts move chips from rear hopper to spread hopper
- C. Screen filters out oversized chips and debris

INFORMATION SHEET

D. Agitator (auger) spreads chips evenly over roller

E. Roller pushes chips through gates and onto oil

VIII. Principles of spreader operation

A. Spreader follows asphalt distributor and spreads chips onto tacky surface

(NOTE: Rollers compress the chips into the asphalt or emulsion making a waterproof, solid surface.)

B. Type of spreader and conditions may require one to three operators

(NOTE: Some newer models are designed to be operated by one person under clear conditions. Other models require one operator to run the controls and steer, a second operator to run the conveyor belts, and a third to guide the dump truck and regulate the flow of chips into the rear hopper.)

C. Chips must be spread evenly for complete coverage

D. Oversized chips, grass, mud, roots, and other debris must not be permitted to pass through spreader gates

(NOTE: Any mud or other debris will keep the chips from adhering to the asphalt and will leave streaks. The area will have to be cleaned and repaired.)

E. Hoppers must not be allowed to overflow

(NOTE: Overflow causes uneven coverage or bulges in the surface. Also, a roller going over a pile of chips will tilt, digging the downhill edge of the roller into the new surface. Overflow must be shoveled and removed by hand.)

F. Gates must be adjusted for each operation

(NOTE: The width of the gate opening and the number of gates must be set according to chip size and width of roadway.)

G. Spreader must lay enough chips to cover all oil in one layer

(NOTE: Too few chips will leave exposed asphalt; too many will leave loose chips that will be torn up and thrown by traffic.)

H. Spread should be as continuous as conditions permit

IX. Responsibilities of primary operator, conveyor belt operator, and truck guide operator (Job Sheets #5-#7)

A. Primary operator (sits at controls)

1. Operates controls

2. Steers spreader

3. Opens and closes gates

4. Adjusts gate openings for size of chips being spread

5. Watches asphalt distributor for any problems with spray

   EXAMPLES: Uneven spray, plugged nozzles

6. Stays alert to problems with spreader

   EXAMPLES: Oversized chips or mud, end of chip load, uneven spreading

B. Conveyor belt operator (stands at front right corner, above hopper)

1. Keeps front hopper filled with chips

   (NOTE: Hopper must not be allowed to overflow.)

2. Adjusts rate of flow

3. Adjusts location of flow

   (NOTE: Chips flow out in pyramids, so that they pile up in the center and drift to the corners. If chips get low, corners will be empty and the flow must be adjusted. Additionally, on shoulder operations, chips must flow to one side of the hopper. For patching operations, it may be best to have the chips flow into the center.)

4. Keeps screen cleared of oversized chips and debris

5. Signals primary operator to stop when necessary

   (NOTE: If hopper runs out of chips, it is essential that the spreader stop. If the spreader runs on fresh oil, chips will not adhere and tracks will be left in the surface. These tracks, or ruts, can catch a tire and throw a vehicle off the road.)

6. Watches surface for even spreading

C. Truck guide operator (stands at the rear)

1. Directs truck alignment and hookup

2. Hooks up and releases trucks

3. Regulates chip flow into rear hopper

   (NOTE: Guide signals truck operator to raise or hold bed. Flow of chips into the rear hopper should be consistent with flow to front hopper. Rear hopper must not be allowed to overflow.)

INFORMATION SHEET

4. Watches for overhead hazards when truck bed is raised
5. Watches truck operator for signals about uneven spread
6. Watches surface for even spreading

   (NOTE: In a one-person operation, the primary operator performs all operations. In a two-person operation, the conveyor belt operator performs the truck guide operator's job.)

X. Procedures for effective spreader operation (Job Sheets #4 and #8)

A. Perform all prestart inspection and maintenance procedures

B. Maintain constant speed

C. Keep enough chips in front hopper for an even spread

(NOTE: Hopper level should be kept above screen.)

D. Keep front hopper as full as possible at the end of a truck loading

(NOTE: If the hopper is full as one truck pulls away, there is time for the next truck to hook up before the hopper empties. Do not let hopper overflow.)

E. Feed rear hopper at a rate consistent with the movement of material to the front hopper

F. Do not let hoppers overflow

G. Keep hopper screen cleared of oversized chips and debris

H. Use correct gate opening for size of chips

I. Use correct number of gates for desired width of spread

(NOTE: The hopper is 13 feet across. If you are spreading a shoulder or laying a patch, all gates other than those directly over the hot asphalt material must be closed.)

J. Signal with clear, definite motions

K. Do not run out of chips on fresh oil

L. Watch surface for streaks or uneven spreading

M. If dirt, mud, or debris are in the chips, empty and clean hopper

N. If distributor must stop, do not spread to the end of the asphalt spray

(NOTE: Back up and leave several feet of oil exposed so that there will be no overlay of chips. Distributor will spray a fresh layer of oil when operation starts again.)

INFORMATION SHEET

O. Water chips if excessively dusty

(NOTE: When using asphalt emulsion, chips *must* be kept wet.)

P. Check conveyor belts for tightness every day

Q. Keep distance between distributor and spreader as short as possible

(NOTE: This is actually the responsibility of the distributor operator. But if the distributor gets too far ahead, the spreader operator should signal the distributor operator to slow down. If there is too much distance between the distributor and the spreader, the oil may cure to the point that the chips will not stick. Also traffic will drive between spreader and distributor if there is room.)

R. Remove spread hopper when transporting spreader

S. Close gates when spreader stops

(CAUTION: Do not operate the spread roll and agitator for prolonged periods with gates closed.)

SPREADER (SELF-PROPELLED)
UNIT VIII

JOB SHEET #1--PERFORM PRESTART INSPECTION AND MAINTENANCE PROCEDURES ON A SPREADER

I. Equipment and materials

A. Spreader

B. Operator's manual

C. Engine oil

D. Engine coolant

E. Hydraulic fluid

F. Fuel

G. Lubricants

H. Grease gun

I. Rags

II. Procedure

(NOTE: Deficiencies should be corrected immediately or reported to the proper authority. Do not operate defective equipment.)

A. Make a walk-around visual inspection for leaks and broken, worn, or missing parts

B. Check engine oil level; add or change oil if necessary

C. Check engine coolant level; add coolant if needed

D. Check hydraulic reservoir level if machine is so equipped; add fluid if needed

E. Check fuel level; fill tank if necessary

F. Check battery connections for tightness and corrosion

G. Check battery electrolyte level; add water if needed

H. Check air cleaner; remove and clean filter if necessary

I. Check brakes

J. Check tires

JOB SHEET #1

K. Clean and lubricate all grease fittings according to operator's manual

L. Check hydraulic system (if machine is so equipped) for leaking lines and connections, bent or kinked lines, and lines rubbing against other parts

M. Check drive belts for tightness

N. Check electrical wire connections and insulation

O. Check gauges

P. Check foot pedals for proper functioning

Q. Check levers and controls for proper functioning

R. Remove trash

S. Check lights

T. Check safety devices

U. Check auger wear plates located at each end of auger; replace as needed

V. Check control gauge for even spacing between gate edge and spread-roll perimeter

W. Clean loose chips and gravel from operator's stations

X. Clean grease, asphalt material, and dirt from ladders and grips

Y. With rake, clean screenings under belt plates at rear

Z. Oil auger chain

SPREADER (SELF-PROPELLED)
UNIT VIII

JOB SHEET #2--SERVICE A SPREADER

I. Equipment and materials

- A. Spreader
- B. Operator's manual
- C. Tool kit
- D. Air supply
- E. Grease gun
- F. Lubricants
- G. Cleaning solvents
- H. Rags
- I. Water
- J. Engine coolant
- K. Engine oil
- L. Hydraulic fluid
- M. Transmission fluid
- N. Brake fluid
- O. Tire pressure gauge
- P. Fuel

II. Procedure

(NOTE: Follow departmental preventive maintenance program when servicing equipment. Refer to operator's manual for lubrication chart and for servicing specific components and attachments.)

A. Visually inspect for leaks and broken, worn, or missing parts

(NOTE: Major repairs and replacements should be reported to the proper authority and completed by a trained mechanic.)

B. Check engine oil level, filter, lines, and hoses; add engine oil if needed

JOB SHEET #2

C. Check engine coolant level, radiator cap, hose, and radiator; add coolant if needed

(CAUTION: Do not remove radiator cap unless engine is cool; then, open cap slowly to release pressure.)

D. Clean air filter; replace if necessary

E. Check fuel level, fuel filters, and sediment bowl (where applicable); fill fuel tank if necessary

F. Check battery electrolyte level, battery cables, and connectors; add water or electrolyte if needed

(CAUTION: Keep sparks and fire away from battery.)

G. Check exhaust system for loose connections and holes

H. Check hydraulic fluid level (if machine is so equipped), filters, hose, lines, and fittings; look for leaks; add fluid if needed

I. Check transmission fluid level; add fluid if needed

J. Check transmission pressure line filter and breather

K. Check brake adjustment and condition; adjust if necessary

L. Check brake master cylinder fluid level; fill with fluid if needed

M. Check clutch adjustment; adjust if necessary

N. Check drive belts for tension and wear; adjust or replace if necessary

O. Check wiring, insulation, and connections

P. Clean and lubricate all grease fittings according to operator's manual

Q. Check condition of tires

R. Check tire pressure; inflate to recommended pressure if necessary

S. Check all safety devices; repair if necessary

T. Check major components and/or accessories

   1. Conveyor belt for tension; adjust if needed

   2. Auger chain drive for proper tension; adjust if needed

SPREADER (SELF-PROPELLED)
UNIT VIII

JOB SHEET #3--START, WARM UP, OPERATE, AND SHUT DOWN A SPREADER

I. Equipment

A. Spreader

B. Operator's manual

II. Procedure

A. Mount spreader using ladder and grab irons

B. Make sure that transmission gearshift lever is in neutral position

C. Open throttle about one-quarter to one-third open

(NOTE: Add choke if necessary.)

D. Engage starter switch

(NOTE: If engine fails to run, do not attempt to restart until engine has come to rest.)

E. Allow engine to warm up

F. Open proper number of gates for width of spread

(NOTE: For the purposes of this job sheet, assume that you will spread a section of roadway 12 feet wide.)

G. Set gate opening width

1. Loosen pawl stop and slide to position that will give desired hopper gate opening

2. Tighten or close stop

(NOTE: When beginning operation, pull gate opener lever to the stop, and make final gate adjustments by moving lever forward and back as required and by repositioning pump.)

H. Depress clutch

I. Select first gear high range

(NOTE: Second gear high range and third gear low range offer the two most convenient operating speeds, but for operators new to the machine, first gear high range is the recommended starting gear. The following chart indicates gear selection for various speeds. Experiment as you operate the spreader.)

(CAUTION: Shift range selector only when unit is stopped.)

JOB SHEET #3

FORWARD SPEED CHART

GEAR	RANGE	
	HIGH	LOW
1st	1.9 mph = 164 fpm	1.3 mph = 118 fpm
2nd	3.4 mph = 300 fpm	2.4 mph = 215 fpm
3rd	5.7 mph = 505 fpm	4.1 mph = 364 fpm
4th	9.3 mph = 819 fpm	6.7 mph = 590 fpm
5th	13.8 mph = 1213 fpm	9.9 mph = 873 fpm

(NOTE: This chart is based on a 2400 rpm engine speed and 10.00 x 20 tires.)

J. Increase throttle operating speed

(NOTE: Adjust pawl stop if needed.)

K. Place transmission in gear

(NOTE: A spreader uses a four-speed transmission.)

L. Move forward/reverse lever forward until desired travel speed is reached

M. Press spread roll/agitator button and open gates by pulling gate lever back to the stop

N. Practice steering and opening and closing gates

(CAUTION: Do not operate spread roll and agitator for prolonged periods with gates closed.)

O. Apply foot brake and stop spreader

P. Shift gear ranges and repeat operating procedures

Q. To shut down, close gates and stop spreader

R. Place all levers in neutral position

S. Set emergency brake

T. Allow engine to idle at one-fourth to one-third throttle

U. Completely shut down throttle

V. Turn off key or electrical system master switch

W. Dismount properly

SPREADER (SELF-PROPELLED)
UNIT VIII

JOB SHEET #4–REMOVE HOPPER FOR TRANSPORT

(NOTE: The spread hopper is wider than the legal limit and must be removed to transport the spreader to the job site.)

I. Equipment, materials, and personnel

   A. Spreader

   B. Front-end loader

   C. Loader operator

   D. Chain

   E. Pry bar

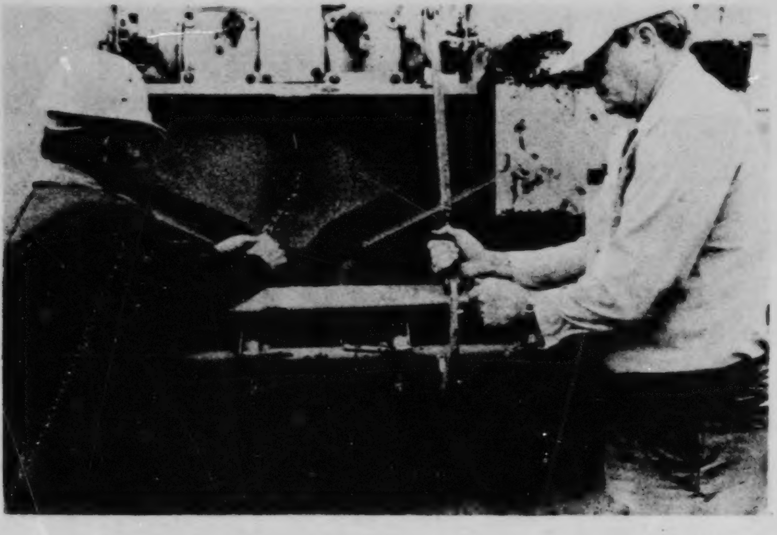
   F. Tilt-trailer or other transport, and loading area

   G. Helper

II. Procedure

   A. Remove safety chain and control lever (Figure 4)

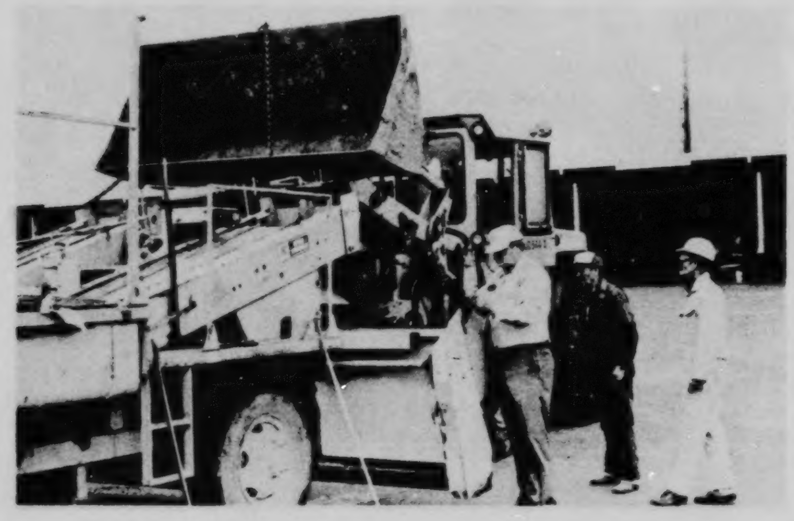
FIGURE 4



JOB SHEET #4

B. Hook up chains to front-end loader (Figure 5)

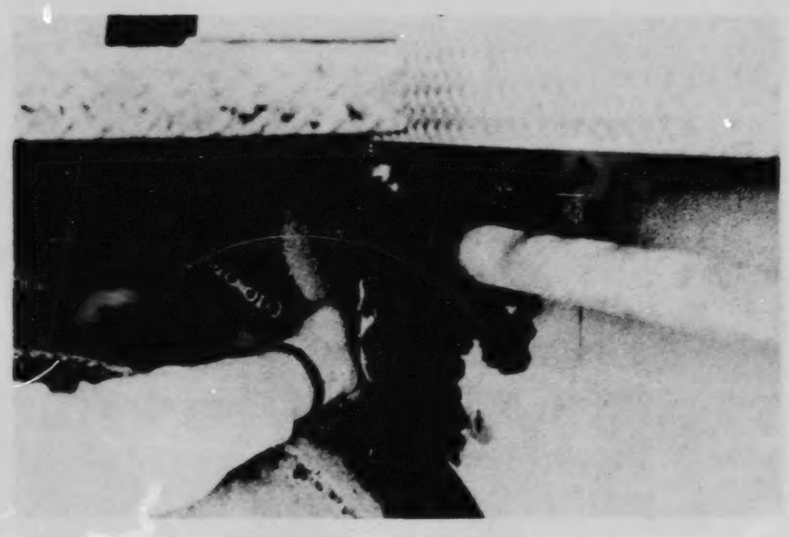
FIGURE 5



C. Remove drive chain under hopper on right-hand side (Figure 6)

(NOTE: Locate and disconnect master link.)

FIGURE 6

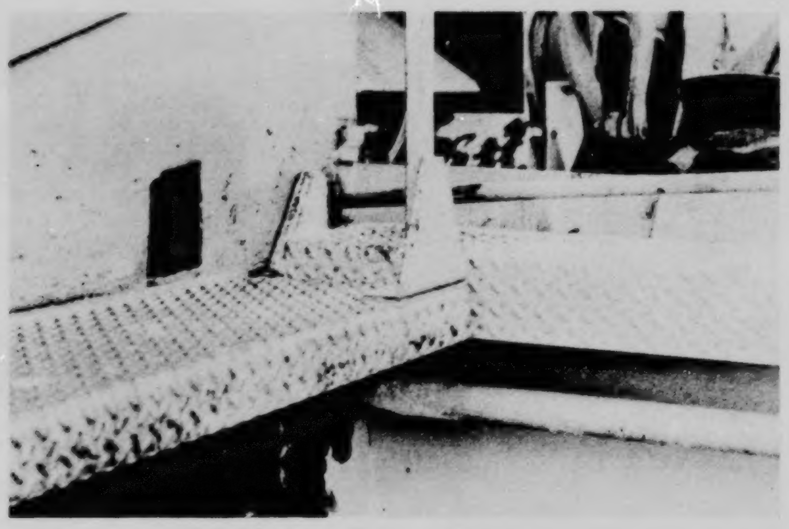


JOB SHEET #4

D. Push in spring locks with pry bar, or turn according to manufacturer's instructions, to release hopper (Figure 7)

(CAUTION: Do not use fingers to push in spring locks.)

FIGURE 7



E. Let hopper fall forward, free of lower center catch

(NOTE: Loader lifts hopper and places it on trailer.)

F. Secure hopper to trailer

G. To reattach spread hopper, reverse above procedure

SPREADER (SELF-PROPELLED)
UNIT VIII

JOB SHEET #5--OPERATE CONTROLS ON A CHIP SEAL OPERATION

I. Equipment, materials, and personnel

- A. Spreader
- B. Operator's manual
- C. Four 4" x 4" x 18" wood blocks
- D. Asphalt distributor and operator
- E. Dump truck and operator
- F. Chips
- G. Recommended safety equipment
    1. Hard hat
    2. Gloves
    3. Goggles
    4. Respirator

II. Procedure

- A. Make a visual inspection of the spreader and correct minor deficiencies
- B. Mount spreader using ladder and grab irons
- C. Sit in operator's seat
- D. Perform starting and warm-up procedures
- E. Manipulate controls to make sure that they are working and are set as required for desired distribution
- F. Signal dump operator to start filling receiving hopper
- G. Signal conveyor belt operator to engage conveyor belt clutches to move the chips to spread hopper
- H. Signal asphalt distributor operator to start applying liquid asphalt material
- I. Start agitator/spread roll
- J. Release emergency brake
- K. Shift to second gear high range and accelerate enough to attain spreading speed by the time beginning point is reached

JOB SHEET #5

L. Pull gate opener lever to pawl stop

(NOTE: Be on the lookout for problem signals from others involved in the operation.)

M. Guide spreader so that fresh liquid asphalt is completely covered with chips

(NOTE: Should any foreign material become lodged in the gates, pull gate override lever to full open position. When object has cleared, quickly return gate opener lever to pawl stop.)

N. When it is necessary to stop spreader before reaching end of project, use the following procedures

  1. Signal conveyor belt operator to stop conveyor belts
  2. Close spreader gates
  3. Disengage agitator/spread roll
  4. Stop spreader
  5. Unhook haul truck from receiving hopper and move it back 45 feet to 50 feet
  6. Move spreader back 25 feet to 30 feet from end of spread
  7. Correct problem and resume spreading

O. Repeat steps F through M

P. Continue this operation until the project is completed

(NOTE: Keep the chip spreading operation as close to the asphalt distributor as is safely possible.)

Q. As spreader nears end of project, signal conveyor belt control operator to stop conveyor belts

R. Close spreader gates

S. Disengage agitator/spread roll

T. Unhook haul truck from spreader

U. Move spreader from roadway to a safe and fairly level parking area

V. Set emergency brake

W. Perform shutdown operation

JOB SHEET #5

X. Dismount from spreader in a safe manner

Y. Block rear wheels both front and back

Z. Make a final visual inspection; write down any deficiencies and report them to the proper authority

SPREADER (SELF-PROPELLED)
UNIT VIII

JOB SHEET #6--CONTROL CONVEYOR BELTS ON A CHIP SEAL OPERATION

I. Equipment, materials, and personnel

- A. Spreader
- B. Operator's manual
- C. Asphalt distributor and operator
- D. Dump truck and operator
- E. Chips
- F. Recommended safety equipment
    1. Hard hat
    2. Gloves
    3. Goggles
    4. Respirator
    5. Close-fitting clothing

II. Procedure

- A. Check receiving hopper and gates for correct setting
- B. Mount spreader using ladder and grab irons
- C. Move forward along right side of spreader to location of conveyor belt controls

    (NOTE: On most models, controls for the conveyor belts are located at the front right corner of the spreader, above the spread hopper.)
- D. Manipulate controls of conveyor belts and baffle plates to determine if they are operating properly
- E. Check with primary operator for signal to start operations
- F. When ready signal is given, engage clutch and start conveyor belts so that chips will move from receiving hopper to spread hopper
- G. Adjust baffle plates if flow of chips to all sections of spread hopper is not adequate

JOB SHEET #6

H. When spread hopper is full enough for an even spread, signal primary operator that all is ready to begin

I. Be alert at all times for any malfunctions of working parts of spreader, and signal primary operator to stop when problems arise

J. Keep spread hopper full enough for an even spread

   1. If flow of chips to spread hopper is too fast, reduce rear gate opening

   2. If flow of chips to spread hopper is too slow, increase rear gate opening

K. Adjust baffle plates as necessary to keep chips spread the full width of spread hopper

L. When chips run low for any reason, signal primary operator to stop

M. Make any corrections or adjustments before proceeding

N. When adjustments or corrections have been made, and spread hopper is filled, signal primary operator to proceed

O. Keep screen on receiving hopper free of oversized chips and debris

P. Watch primary operator for signal to stop

Q. At "stop" signal, disengage the conveyor belt clutches immediately

(NOTE: This will prevent the hopper from overflowing.)

R. When primary operator signals to start again, engage conveyor belt clutches and keep spread hopper filled

S. Continue with this procedure until programmed spreading is completed

T. On signal from primary operator that job is completed, disengage conveyor belt clutches

U. After spreader has come to a complete stop, walk to ladder and climb down in a safe manner

SPREADER (SELF-PROPELLED)
UNIT VIII

JOB SHEET #7--GUIDE TRUCK OPERATOR ON A CHIP SEAL OPERATION

I. Equipment, materials, and personnel

  A. Spreader and operators

  B. Dump trucks and operators

  C. Asphalt distributor and operator

  D. Chips

  E. Recommended safety equipment

    1. Hard hat

    2. Gloves

    3. Goggles

    4. Respirator

II. Procedure

  A. Mount spreader using ladder and grab irons; take position on rear platform

  B. Locate release lever and hookup

  C. As truck backs up to spreader, guide driver so that truck backs in straight with about 8 inches clearance on each side of hopper

  (NOTE: If truck does not back *straight* in, wheels will drag on newly laid surface and damage it.)

  D. Signal driver to keep backing until bar is aligned with hook

  E. Push lever to lock hook over bar

  (NOTE: Truck driver will put the truck in neutral, and the spreader will tow the truck.)

  F. Signal driver, raise dump bed until receiving hopper is approximately half full, and then signal to hold

  G. Signal conveyor belt operator that truck is ready to load rear hopper

  H. Raise truck bed until it is almost to the FULL-UP position while signalling truck operator to trip tailgate

JOB SHEET #7

I. As belts carry chips out of hopper, signal truck operator to raise or hold bed as needed

(NOTE: Keep flow into rear hopper consistent with flow of chips into front hopper. Do not let hopper overflow.)

J. While loading

1. Watch for overhead obstructions such as power lines and trees
2. Watch truck operator for signals regarding uneven spread
3. Watch surface for signs of uneven spread

K. Signal driver that you will release truck

L. Pull release lever to free hook

(NOTE: Truck operator lets spreader pull away, lowers bed while coming to a slow stop that will not damage the surface, puts truck in forward gear, and pulls away. As this truck leaves, another will pull in.)

M. While trucks are changing, check surface for uneven spread

N. Guide next truck into position and repeat procedure

SPREADER (SELF-PROPELLED)
UNIT VIII

JOB SHEET #8--CHIP SEAL A ROADWAY

I. Equipment, materials, and personnel

- A. Spreader and three operators
- B. Operator's manual
- C. Asphalt distributor and operator
- D. Dump trucks and operators
- E. Chips
- F. Four 4" x 4" x 18" blocks
- G. Recommended safety equipment
    1. Hard hat
    2. Gloves
    3. Goggles
    4. Respirator
    5. Close-fitting clothing

II. Procedure

- A. Make a visual inspection of spreader
- B. Take care of any necessary minor repairs and adjustments
- C. Check to make sure that all gates are set to open
- D. Mount spreader using ladder and grab irons
- E. Sit in operator's seat
- F. Perform starting and warm-up operations
- G. Position spreader 20 feet to 30 feet from start of spreading operation
- H. Make sure that truck and spreader are securely hooked together
- I. Fill receiving hopper
- J. Start conveyor belts and fill spread hopper
- K. Shift transmission into spreading range

L. Release brakes and move forward; accelerate enough to attain spreading speed by the time beginning point is reached

M. Activate agitator and spread rolls and open spreader gates as front of spreader reaches starting point

(NOTE: Make sure that spreader distributes the chips over the full width of the sprayed asphalt.)

N. Maintain correct spreading speed

O. Keep enough material in receiving hopper so that conveyor belts can be activated as needed to supply spread hopper with enough chips for an even cover

P. Be prepared to stop if any of the following should occur

   1. Difficulty in unhooking empty truck
   2. Difficulty in hooking up loaded truck
   3. Failure of conveyor belts to move chips from receiving hopper to spread hopper
   4. Debris clogging the gates

Q. When it is necessary to stop before the finish point is reached, stop conveyor belts, close gates, deactivate agitator/spread rolls, and apply brakes

R. Shift transmission to reverse; back spreader 20 feet to 30 feet and set the emergency brakes

S. When problem has been corrected, repeat steps L through R and continue until programmed spreading has been completed

(NOTE: Stay as near the asphalt distributor with the chip spreader as is safely possible. This will ensure a better bond between chips and hot asphalt.)

Move spreader to a safe, level place

U. Set brakes

V. Perform shutdown operation

W. Dismount spreader in a safe manner

X. Block rear wheels both front and back

Y. Make a final visual inspection; write down any deficiencies and report them to the proper authority

SPREADER (SELF-PROPELLED)
UNIT VIII

TEST

NAME ________________________________ SCORE ______________

1. Match terms associated with spreaders to their correct definitions. Write the correct numbers in the blanks.

_____a. Soak up

_____b. Dust and small particles from rocks

_____c. Machine that spreads chips behind an asphalt distributor

_____d. Crushed rock or gravel screened to sizes for use in road surfaces, concrete, or asphalt mixes

_____e. Excess asphalt material that seeps through to the surface

1. Bleeding
2. Blot
3. Spreader
4. Chips (aggregate)
5. Screenings

2. Select from the following list uses of a self-propelled spreader. Write an "X" in the blank before each correct answer.

_____a. Chip sealing or sand sealing roadways

_____b. Installing culverts

_____c. Blotting runoff

_____d. Laying large chip seal patches

_____e. Laying small patches

_____f. Penetration operations

_____g. Hauling chips from stockpile

_____h. Chip sealing or sand sealing shoulders

_____i. Blotting bleeding

_____j. Chip sealing or sand sealing cold mix

TEST

3. Identify the parts of a spreader. Write the correct numbers in the blanks.

______a. Baffle plates

______b. Gates

______c. Gate control lever

______d. Conveyor controls

______e. Spread roll

______f. Hand brake

______g. Spread roll/agitator control

______h. Truck hook

______i. Spread hopper

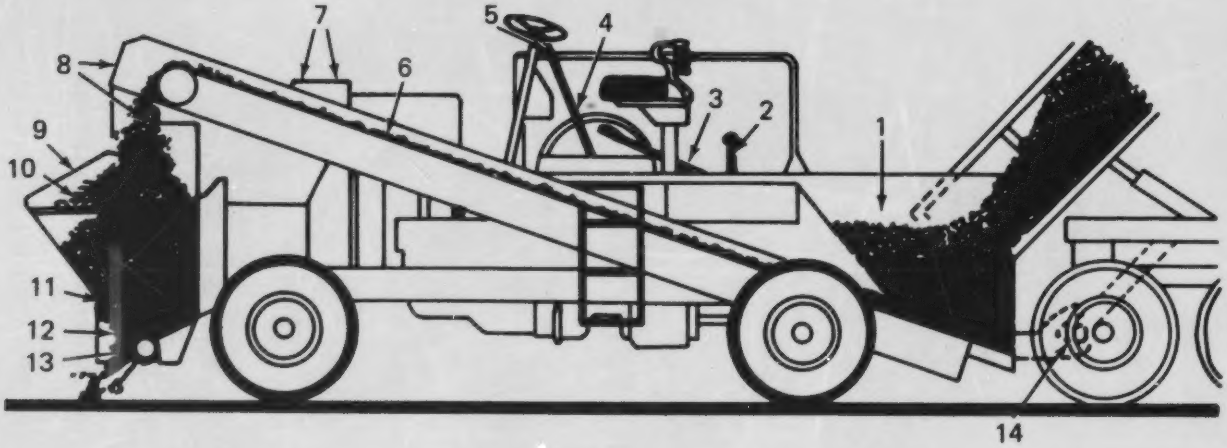
______j. Agitator (auger)

______k. Receiving hopper

______l. Screen

______m. Conveyor belts

______n. Hook lever



TEST

4. Identify the controls on a typical self-propelled spreader. Write the correct the numbers in the blanks.

______ a. Throttle

______ b. Hand brake

______ c. Oil pressure gauge

______ d. Forward/reverse lever

______ e. Tachometer

______ f. Ammeter

______ g. Gate control

______ h. Hydraulic oil pressure gauge

______ i. Choke

______ j. Hydraulic oil temperature gauge

______ k. Transmission control lever

______ l. Quadrant (opens and closes gate)

______ m. Water temperature gauge

______ n. Starter button

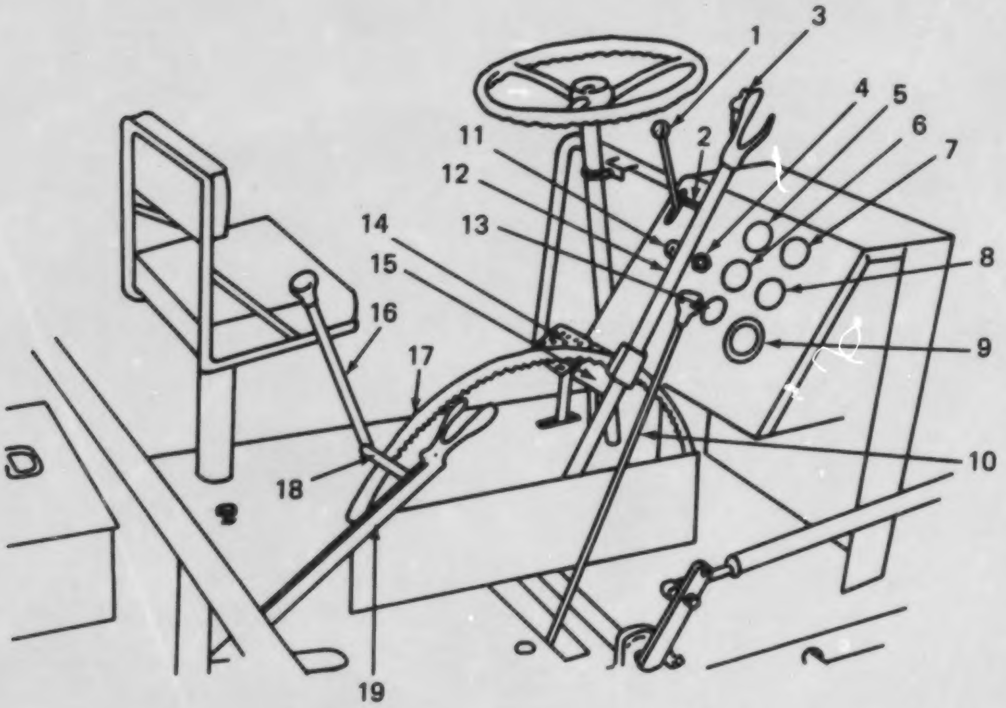
______ o. Brake

______ p. Ignition switch

______ q. Pawl stop (sets gate opening at 1/16-inch intervals)

______ r. Agitator switch

______ s. Clutch



TEST

5. State eight general safety rules for operating equipment.

a. ____________________

b. ____________________

c. ____________________

d. ____________________

e. ____________________

f. ____________________

g. ____________________

h. ____________________

6. State three safety rules for operating a spreader.

a. ____________________

b. ____________________

c. ____________________

7. Arrange in order stages of chip flow through a spreader. Write a "1" before the first stage, a "2" before the second, and so on.

_____a. Screen filters out oversized chips and debris

_____b. Truck loads chips into rear receiving hopper

_____c. Roller pushes chips through gates and onto oil

_____d. Conveyor belts move chips from rear hopper to spread hopper

_____e. Agitator (auger) spreads chips evenly over roller

8. Select from the following list principles of spreader operation. Write an "X" in the blank before each correct answer.

_____a. Chips should be various sizes

_____b. Type of spreader and conditions may require one to three operators

_____c. All gates must be opened equally

_____d. Spreader follows asphalt distributor and spreads chips onto tacky surface

_____e. Type of operation and amount of chips may require one to three operators

_____f. Hoppers must not be allowed to overflow

TEST

______g. Spreader must travel at same speed as distributor

______h. Gates must be adjusted for each operation

______i. Chips must be spread evenly for complete coverage

______j. Spreader must come to a full stop before closing gates

______k. Oversized chips, grass, mud, roots, and other debris must not be permitted to pass through spreader gates

______l. Spreader should stop as each truck hooks up to spreader

______m. Spreader must lay enough chips to cover 60 percent of oil in one layer

______n. Spreader must lay enough chips to cover all oil in one layer

______o. Spread should be as continuous as conditions permit

9. Distinguish among responsibilities of primary operator, conveyor belt operator, and truck guide operator. Write "PO" if the responsibility is the primary operator's, "CBO" if the responsibility is the conveyor belt operator's, or "TGO" if the responsibility is the truck guide operator's. Some blanks may contain more than one answer.

______a. Adjusts rate of flow

______b. Opens and closes gates

______c. Stays alert to problems with spreader

______d. Watches truck operator for signals about uneven spread

______e. Signals primary operator to stop when necessary

______f. Hooks up and releases trucks

______g. Steers spreader

______h. Keeps screen cleared of oversized chips and debris

______i. Watches for overhead hazards when truck bed is raised

______j. Operates controls

______k. Watches asphalt distributor for any problems with spray

______l. Regulates chip flow into rear hopper

______m. Adjusts location of flow

TEST

_____n. Directs truck alignment and hookup

_____o. Watches surface for even spreading

_____p. Keeps front hopper filled with chips

10. State ten procedures for effective spreader operation.

a. ____

b. ____

c. ____

d. ____

e. ____

f. ____

g. ____

h. ____

i. ____

j. ____

(NOTE: Test question 11 lists the job sheets. They are an important part of this test. If they have not been completed, check with your instructor.)

11. Demonstrate the ability to

a. Perform prestart inspection and maintenance procedures on a spreader.

b. Service a spreader.

c. Start, warm up, operate, and shut down a spreader.

d. Remove hopper for transport.

e. Operate controls on a chip seal operation.

f. Control conveyor belts on a chip seal operation.

g. Guide truck operator on a chip seal operation.

h. Chip seal a roadway.

SPREADER (SELF-PROPELLED)
UNIT VIII

ANSWERS TO TEST

1. a. 2
   b. 5
   c. 3
   d. 4
   e. 1

2. a, d, f, h, i

3. a. 8
   b. 12
   c. 4
   d. 7
   e. 13
   f. 3
   g. 5
   h. 14
   i. 9
   j. 11
   k. 1
   l. 10
   m. 6
   n. 2

4. a. 1
   b. 19
   c. 6
   d. 17
   e. 13
   f. 8
   g. 12
   h. 9
   i. 2
   j. 7
   k. 10
   l. 16
   m. 5
   n. 4
   o. 15
   p. 11
   q. 18
   r. 3
   s. 14

5. Answer should include any eight of the following
   a. Read operator's manual thoroughly: know your machine
   b. Study departmental safety manual
   c. Wear safety items required by job conditions
   d. Know and observe hand signals
   e. Be sure all safety guards and covers are in place and secure

ANSWERS TO TEST

f. Do not operate machine until you are sure personnel and obstructions are cleared from area

g. Check all safety devices before moving machine

h. Do not jump on or off machine

i. Mount and dismount properly, using ladder and grab irons

j. Do not allow anyone to ride on machine

k. Know traffic pattern of job and obey spotter

l. Always park on level ground if possible

m. Do not leave engine running unattended

n. Avoid operating too close to banks or overhangs

o. Keep machine clean

6. Answer should include any three of the following

   a. Use traffic control devices

   b. Stay clear of belts

   c. Watch for oncoming traffic

   d. Watch for obstructions

   e. Wear goggles and respirator in dusty conditions

7. a. 3
   b. 1
   c. 5
   d. 2
   e. 4

8. b, d, f, h, i, k, n, o

9. a. CBO
   b. PO
   c. PO
   d. TGO
   e. CBO
   f. TGO
   g. PO
   h. CBO
   i TGO
   j. PO
   k. PO
   l. TGO
   m. CBO
   n. TGO
   o. CBO, TGO
   p. CBO

ANSWERS TO TEST

10. Answer should include any ten of the following
    a. Perform all prestart inspection and maintenance procedures
    b. Maintain constant speed
    c. Keep enough chips in front hopper for an even spread
    d. Keep front hopper as full as possible at the end of a truck loading
    e. Feed rear hopper at a rate consistent with the movement of material to the front hopper
    f. Do not let hoppers overflow
    g. Keep hopper screen cleared of oversized chips and debris
    h. Use correct gate opening for size of chips
    i. Use correct number of gates for desired width of spread
    j. Signal with clear, definite motions
    k. Do not run out of chips on fresh oil
    l. Watch surface for streaks or uneven spreading
    m. If dirt, mud, or debris are in the chips, empty and clean hopper
    n. If distributor must stop, do not spread to the end of the asphalt spray
    o. Water chips if excessively dusty
    p. Check conveyor belts for tightness every day
    q. Keep distance between distributor and spreader as short as possible
    r. Remove spread hopper when transporting spreader
    s. Close gates when spreader stops

11. Performance skills evaluated to the satisfaction of the instructor

MUD JACK
UNIT IX

UNIT OBJECTIVE

After completing this unit, the student should be able to operate a mud jack safely and effectively. This knowledge will be shown by completing job sheets and unit test with a minimum score of 85 percent.

SPECIFIC OBJECTIVES

After completing this unit, the student should be able to

1. Match terms associated with mud jacks to their correct definitions.
2. Select from a list uses of mud jacks in highway maintenance.
3. Identify the parts of a mud jack.
4. Match mud-jack controls to their proper functions.
5. Arrange in order steps in a mud-jacking operation.
6. State safety rules for operating a mud jack.
7. State rules for effective mud-jack operation.
8. Demonstrate the ability to
    a. Perform prestart inspection and maintenance procedures on a mud jack.
    b. Service a mud jack.
    c. Start, warm up, operate, and shut down a mud jack.
    d. Clean a mud jack.
    e. Level a concrete slab.
    f. Level asphalt pavement or stabilize a fill.

MUD JACK
UNIT IX

SUGGESTED ACTIVITIES

I. Suggested Activities

A. Order materials to supplement unit.

1. Films

a. *Hear What You Want to Hear.* 16mm, color, 10 minutes, National Safety Council. Available from National Safety Council, P.O. Box 11933, Chicago, Illinois 60611, 312-527-4800. Order # 143.03-9.

(NOTE: This film creates employee involvement in safety through audience participation, and encourages use of hearing-protection devices.)

b. *Your Body Is Only Human.* 16mm, color, 10 minutes. National Safety Council. Available from National Safety Council, P.O. Box 11933, Chicago, Illinois 60611, 312-527-4800. Order # 147.27-9.

(NOTE: This film investigates the relationship between mind and body in establishing safe work patterns.)

2. Slide show--*It's Your Hearing.* 30 slides, without cassette, National Safety Council. Available from National Safety Council, P.O. Box 11933, Chicago, Illinois 60611, 312-527-4800. Order # 176.25-9.

(NOTE: This show zooms in on dangers to hearing from exposure to excessive noise. It recommends use of ear protectors in noisy areas.)

B. Provide students with objective sheet.

C. Provide students with information and job sheets.

D. Discuss unit and specific objectives.

E. Discuss information sheet.

F. Demonstrate and discuss procedures outlined in job sheets.

G. Develop alternate jobs if job sheets are not practical.

H. Arrange a field trip for students to observe mud-jacking operations.

I. Arrange a field trip for students to observe stabilizing operations.

J. Demonstrate different consistencies of slurry and discuss composition, thickness, and fill properties.

SUGGESTED ACTIVITIES

K. Stress the need for cooperation and concentration while operating the mud jack.

L. Review operating and safety procedures for compressors and rock drill.

M. Give test.

II. Instructional materials

A. Objective sheet

B. Suggested activites

C. Information sheet

D. Job sheets

1. Job Sheet #1--Perform Prestart Inspection and Maintenance Procedures on a Mud Jack

2. Job Sheet #2--Service a Mud Jack

3. Job Sheet #3--Start, Warm Up, Operate, and Shut Down a Mud Jack

4. Job Sheet #4--Clean a Mud Jack

5. Job Sheet #5--Level a Concrete Slab

6. Job Sheet #6--Level Asphalt Pavement or Stabilize a Fill

E. Test

F. Answers to test

III. Unit references

A. *Instruction Book and Parts List: Hydra Jack HJ11B.* Cincinnati, Ohio: Air Placement Equipment Co., Inc., 1968.

B. *Mud Jack Promotional Material.* Dayton, Ohio: Koehring Co., n.d. (out of print).

MUD JACK
UNIT IX

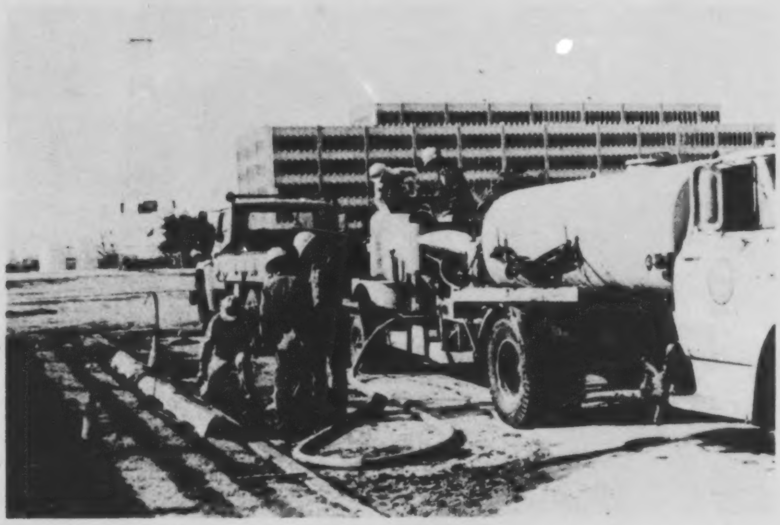
INFORMATION SHEET

I. Terms and definitions

A. Mud jack--Gasoline-powered pump that forces soil material mixed with water and portland cement through a hose and nozzle (Figure 1)

EXAMPLE:

FIGURE 1



B. Slurry (mud)--Material created by mixing water with fine solid materials such as soil, portland cement, or fly ash

C. Mud jacking--Raising surface by forcing slurry under the slab

D. Void--Empty space or air pocket

E. Filling slurry--Mixture thin enough to fill all voids

F. Raising slurry--Mixture thick enough to lift surface

G. Stabilize--To inject slurry into fills, dams, or subbase to prevent further settlement or slippage

H. Injection point--Needlelike attachment for placing slurry deep (48 inches to 96 inches) under surface; used for stabilizing and for leveling asphalt pavement

I. Boot--Device for plugging holes

INFORMATION SHEET

II. Uses of mud jacks in highway maintenance

- A. Raising depressed concrete

  EXAMPLES: Pavement slabs, sidewalks, curbs, gutters

- B. Raising depressed asphalt pavement
- C. Stabilizing fill

  (NOTE: Fill will settle and leave uneven support for surface areas.)

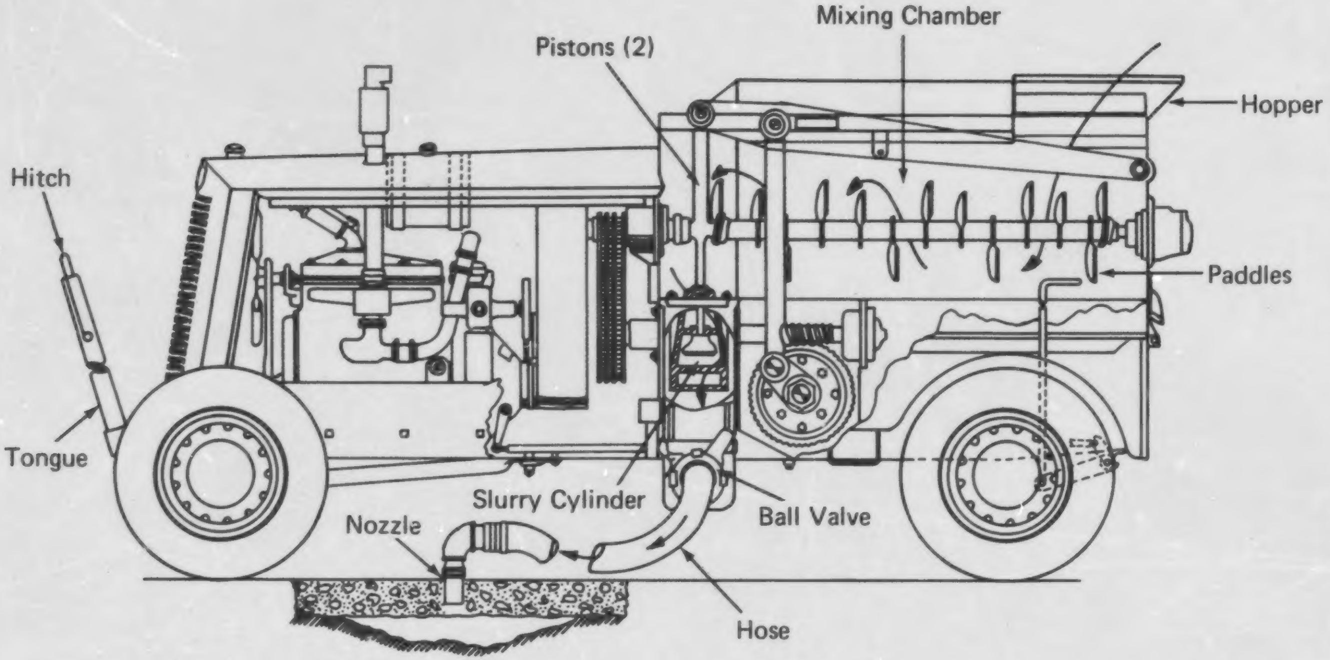
- D. Correcting and stabilizing settled utility trenches
- E. Stabilizing behind and around bridge abutments

INFORMATION SHEET

III. Parts of a mud jack (Figures 2-4; Job Sheets #1-#4)

(NOTE: Arrows indicate flow of material through pump. Some units are equipped with a two-way valve that allows material to flow into two places at once, or material can be recirculated into mixing chamber.)

FIGURE 2


Mixing Chamber
Pistons (2)
Hopper
Hitch
Paddles
Tongue
Slurry Cylinder
Ball Valve
Nozzle
Hose

Adapted with permission of Voeller Incorporated, Port Washington, Wisconsin.

INFORMATION SHEET

FIGURE 3 INJECTION POINT

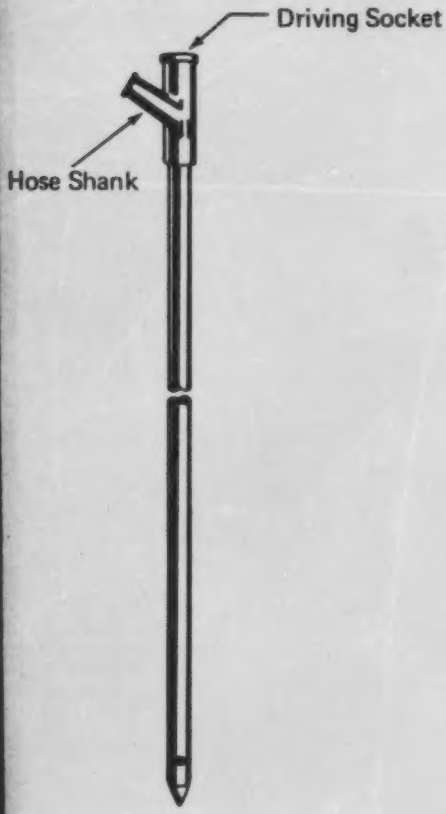
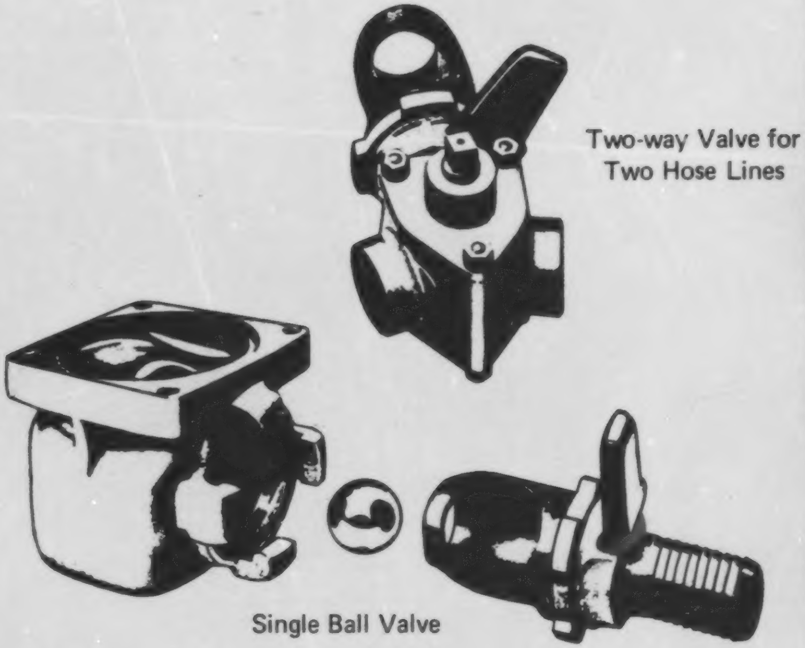

Driving Socket
Hose Shank

FIGURE 4 VALVES


Two-way Valve for Two Hose Lines
Single Ball Valve

Adapted with permission of Voeller Incorporated, Port Washington, Wisconsin.

INFORMATION SHEET

IV. Mud-jack controls and their functions (Figures 5-8; Job Sheet #3)

(NOTE: Controls will vary with manufacturer and model.)

A. Clutch--Engages or disengages pump

B. Throttle--Adjusts engine speed

C. ON/OFF switch--Shuts down engine

D. Main water valve--Controls water flow into mixing chamber

EXAMPLES:

FIGURE 5 **Clutch**

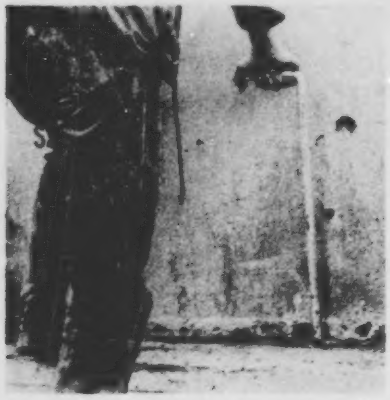


FIGURE 6 **Throttle**

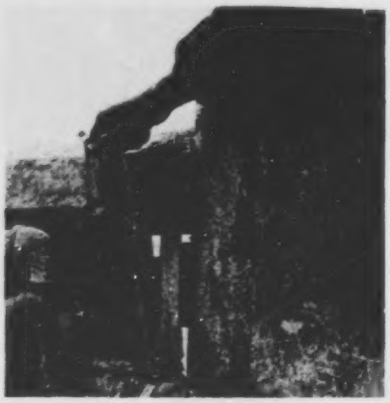


FIGURE 7 **ON/OFF Switch**

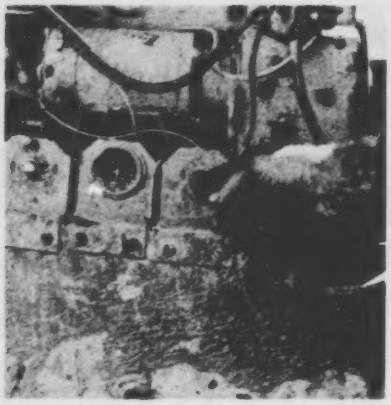
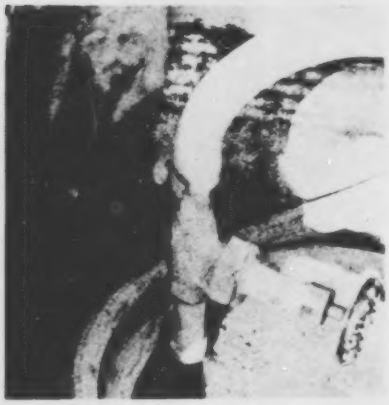


FIGURE 8 **Main Water Valve**



INFORMATION SHEET

V. Steps in a mud-jacking operation (Job Sheets #4-#6)

(NOTE: Mud jacking requires a four- or five-person crew: two persons on the shovel crew, two on the hose crew, and a pump operator. Some operations use two hoses. A supervisor directs the operation.)

A. Supervisor places string line at desired height

B. Hose crew drills evenly spaced holes with a pneumatic rock drill

(NOTE: For stabilizing operations, injection or needle nozzles are driven into the ground with a paving breaker. Spacing and positioning of holes depend on the character of the subgrade material, the kind of soil available for mixing, and the condition and size of the slab.)

C. Mud-jack operator starts water and mixer

D. Shovel crew, directed by mud-jack operator, feeds soil material mixed with portland cement into mud jack

(NOTE: Filling slurry is used at the start. When small cracks and crevices have been filled, raising slurry is used to lift the slab. Filling slurry is again used to fill voids under raised slab. Mud-jack operator adjusts water and material during operation to maintain the desired consistency.)

E. Hose crew fits nozzle into hole; two people stand on pad to hold it in place

(NOTE: Once pumping starts, the nozzle will raise with enough force to lift a person off the ground.)

F. Mud-jack operator starts pump

G. Pumping continues until surface reaches desired height or until slurry leaks out of one of the other holes

H. Pumping stops

I. Hose crew plugs leaking hole with boot or other device

J. Hose crew moves nozzle to different hole

(NOTE: Slab must be raised gradually and evenly or it will crack. Each part is raised 1/8 inch to 1/4 inch at a time; then another section is raised from a different hole. Hose is applied to alternating holes, working from the center of slab to the edge, and the process is repeated until the slab is level at the correct height.)

K. Supervisor measures raised distance at several points along string line

L. When slab approaches desired height, mud-jack operator thins material to filling-slurry consistency

M. Operation continues until slab is level at desired height

INFORMATION SHEET

VI. Safety rules for operating a mud jack

(NOTE: People, not machines, cause accidents!)

A. Read operator's manual thoroughly: know your machine

B. Study departmental safety manual

C. Wear recommended safety equipment

EXAMPLES: Hard hat
Visible vest
Close-fitting clothing
Goggles to keep dirt and mud out of eyes
Hard-toed shoes (hoses are rock-hard when filled with mud)
Respirator when needed

D. Use traffic-control devices

E. Keep hands away from moving parts

F. Keep shovels and tools away from rotors

G. Watch footing when unit is moving and when stepping down from unit

VII. Rules for effective mud-jack operation (Job Sheets #1, #4, and #5)

(NOTE: The operator needs four eyes for this job: He or she must direct the shovel crew, watch the consistency of the slurry, watch for signals from the hose crew, and operate the water valves. The operator must be alert at all times and must work quickly.)

A. Perform all prestart inspection and maintenance procedures

B. Park equipment on stable slab

C. Make sure all hose connections are secure

D. Make sure soil material is clean (free of grass and debris)

E. Check water level in the tank periodically

F. Operate at full throttle

G. Keep pumps supplied with material at all times

H. Adjust water and soil material as needed

I. Watch nozzle operators for signals

(NOTE: Nozzle operators will signal when to start and stop pumping. The operation must be coordinated so that operators are holding the nozzles firmly when pumping begins.)

INFORMATION SHEET

J. Begin operation with filling slurry, and then thicken to proper consistency

(NOTE: Filling slurry fills small cracks and crevices. Raising slurry will force material into these areas).

K. Keep raising slurry at a constant consistency

L. Add more water to thin slurry material when slab is within 1/8 inch of string line

(NOTE: Thinner slurry will fill all remaining voids and crevices.)

M. Clean pump, hoses, and nozzles *thoroughly* after each use

(NOTE: If pump is not properly cleaned, slurry will set up and will have to be chipped out.)

MUD JACK
UNIT IX

JOB SHEET #1–PERFORM PRESTART INSPECTION AND MAINTENANCE PROCEDURES ON A MUD JACK

I. Equipment and materials

A. Mud jack

B. Operator's manuals for pump and engine

C. Water truck

(NOTE: Maintenance of water truck is mud-jack operator's responsibility.)

D. Operator's manual for water truck

E. Engine oil

F. Engine coolant

G. Fuel

H. Lubricants

I. Grease gun

J. Rags

II. Procedure

(NOTE: Any equipment defects should be corrected immediately or reported to the proper authority. Do not operate defective equipment.)

A. Make a walk-around visual inspection for leaks and for broken, worn, or missing parts

B. Check engine oil level; add or change engine oil if needed

C. Check engine coolant level; add coolant if needed

D. Check fuel level; fill tank if necessary

E. Check air cleaner; remove and clean or replace filter if necessary

F. Check tires

G. Clean and lubricate all grease fittings according to operator's manual

(NOTE: Lubricate pump and engine parts.)

H. Check tightness of drive belts on engine and pumps

JOB SHEET #1

I. Check levers and controls for proper functioning

J. Check hitch

K. Check water-hose connections

L. Start pump; check bolts and look and listen for any misalignments or unusual operation; correct as needed

M. Check hoses and nozzles

N. Check safety devices

O. Check shovels for broken or split handles

P. Check boots or other plugging devices

Q. Check hose-cleaning tools

MUD JACK
UNIT IX

JOB SHEET #2--SERVICE A MUD JACK

I. Equipment and materials

A. Concrete pump

B. Operator's manual

C. Tool kit

D. Grease gun

E. Lubricants

F. Cleaning solvents

G. Rags

H. Water

I. Engine coolant

J. Engine oil

K. Tire-pressure gauge

L. Fuel

II. Procedure

(NOTE: Follow departmental preventive-maintenance program when servicing equipment. Refer to operator's manual for lubrication chart and for manufacturer's recommendations concerning service of specific components and attachments.)

A. Visually inspect for leaks and for broken, worn, or missing parts

(NOTE: Major repairs and replacements should be reported to the proper authority and completed by a trained mechanic.)

B. Check engine oil level, filter, lines, and hoses; add or change engine oil if necessary

C. Check engine-coolant level, radiator cap, hose, and radiator; add coolant if needed

(CAUTION: Do not remove radiator cap unless engine is cool; when engine is cool, open cap slowly to release pressure.)

JOB SHEET #2

D. Clean air filters; replace if necessary

E. Check fuel level, fuel filters, and sediment bowl (where applicable); fill fuel tank if necessary

F. Check battery electrolyte level, battery cables, and connectors; add water or electrolyte if needed

(CAUTION: Keep sparks and fire away from battery.)

G. Check exhaust system for loose connections and holes

H. Check clutch adjustment; adjust if necessary

I. Check drive belts for tension and wear; adjust or replace if necessary

J. Check wiring, insulation, and connections

K. Clean and lubricate all grease fittings according to operator's manual

L. Check condition of tires

M. Check tire pressure; inflate to recommended pressure

N. Check all safety devices; repair as needed

O. Check major components and/or accessories

1. Service pumps according to manufacturer's recommendations
2. Check condition of rotors
3. Inspect pistons and adjust as needed

MUD JACK
UNIT IX

JOB SHEET #3–START, WARM UP, OPERATE, AND SHUT DOWN A MUD JACK

I. Equipment, materials, and personnel

A. Mud jack

B. Operator's manual for pump and engine

C. Water source

D. Soil material and portland cement

E. Dump truck

F. Two persons to shovel soil material and portland cement

II. Procedure

A. Perform all prestart inspection and maintenance procedures

B. Connect water hose to pump; check couplings and open water-supply valve

C. Disengage clutch

D. Start engine

E. Open throttle one-third to one-half

F. Allow engine to warm up

G. Open throttle completely

H. Flush hopper with water

I. Engage clutch

J. Pump water through system

K. Signal shovelers to add soil material and portland cement

L. Adjust water flow as needed to maintain proper slurry consistency

(NOTE: Experiment and locate the water-valve stops for filling mud and for raising mud. You may want to mark the stops with wire or tape.)

M. Practice directing shovelers and adjusting amount of material fed into hopper

JOB SHEET #3

N. Start and stop pump on command by engaging or disengaging clutch

O. Shut down machine by disengaging clutch, closing throttle, and moving ON/OFF switch to OFF

P. Turn off water

(NOTE: If using a two-way valve, pump material continuously; control flow by operating valve.)

MUD JACK
UNIT IX

JOB SHEET #4--CLEAN A MUD JACK

I. Equipment and materials

   A. Mud jack

   B. Water source

   C. Water hose

   D. Scraping tool

   E. Rags or sponges

   F. Tool kit

II. Procedure

   (NOTE: Mud-jack unit must be *thoroughly* cleaned each day as soon as possible after work is completed.)

   A. Move pump and water source to clean-up site

   B. Pump all materials from hopper as soon as work is finished

   C. Run water from truck tank through pump, hoses, and nozzle

   D. Stretch out hose or hoses

   E. Start pump

   F. Flush system with clean water and pump through hoses

   G. Shut off engine

   H. Scrape off mud from around cylinders inside unit

      (NOTE: Access hole on the side of the unit allows you to reach in and dig out mud.)

   I. Start pump; flush system with clean water until unit is clean

   J. Stop pump

   K. Disassemble mud valve; clean, reassemble, and replace

   L. Disconnect hose or hoses, and run clean water through them until water runs clear

      (NOTE: Hoses may be cleaned with a sponge. Insert the sponge into the discharge coupling, and fill hopper with clean water. Start pump and allow water to push sponge and material out through hose.)

JOB SHEET #4

M. Wash down outside of machine; turn off water

N. Store hoses and nozzles in their proper places

MUD JACK
UNIT IX

JOB SHEET #5–LEVEL A CONCRETE SLAB

I. Equipment, materials, and personnel

  A. Mud jack with 3-inch material hoses, 2-inch nozzles, and suitable plugs

  B. Operator's manual

  C. Compressor with air hose

  D. Dump truck

  E. Five-hundred gallon (minimum) water transport with water hose

  F. Rock drill with 24-inch drill steel and 2-inch drill bits

  G. Shovels

  H. Portland cement

  I. Material that will flow readily when wet, such as loamy soil or fly ash

  J. Recommended safety equipment

    1. Hard hat

    2. Hard-toed shoes

    3. Gloves

    4. Goggles

    5. Respirator

    6. Close-fitting clothing

  K. Traffic-control devices

  L. Shovel crew

  M. Hose crew

  N. Supervisor

II. Procedure

  A. Perform all prestart inspection and maintenance procedures

  B. Move equipment and materials to job site

  C. Post all required traffic-control devices

JOB SHEET #5

D. Position equipment

E. Supervisor will mark pattern and have 2-inch holes drilled through concrete

F. Connect water hose to water supply and to mud-jack water pump; open water supply valve

G. Attach nozzles to material hose(s)

H. Attach material hose(s) to supply valve(s) on mud jack

(NOTE: A two-way supply valve can be used and is recommended for leveling concrete slabs. By using the two-way valve, the pressure can be switched from one hose to the other, or pressure can be maintained in both hoses by centering the valve opening. By using two hoses with a two-way valve, the pressure under the slab can be controlled, and hoses from one section of the slab can be moved to another section without shutting the machine down.)

I. Have all personnel take their assigned positions

J. Perform starting procedure

K. Instruct workers to insert nozzle(s) in holes

(NOTE: Supervisor will direct placement when you signal. To contain the pressure under the slab, the unused drill holes may have to be plugged.)

L. Signal crew when you are ready to pump

M. Open water valve

N. Turn on material pump and mixer at crew's signal

O. Continue running water, pump, and mixer until hopper, cylinders, pistons, hoses, and area under the slab are wet

P. Signal shovel crew to feed mixer

(NOTE: Watch slurry closely; adjust feed as needed to maintain desired slurry consistency.)

Q. Adjust water supply until slurry is consistency required for desired results

R. Continue mixing and pumping operation until supervisor signals to stop pumping

(NOTE: Supervisor will be measuring the movement of the slab, directing the repositioning of the nozzles, switching the pressure from one hose to the other, or equalizing the pressure in both hoses.)

JOB SHEET #5

S. Shut down pump *immediately*

T. Signal workers to stop feeding hopper

U. Close water valve

(CAUTION: Never leave slurry in material hoses for long periods of time. If operation is to be delayed an hour or more, slurry should be thinned to about the consistency of water.)

V. Repeat signaling, pumping, feeding mixer, and shutting down pump as needed until job is completed

(NOTE: Supervisor will signal when concrete is level at desired height.)

W. Clean unit after job is completed, or at end of work day

X. Remove hoses and store them in their proper places

Y. Move equipment to next job site or park equipment in a safe place overnight

MUD JACK
UNIT IX

JOB SHEET #6--LEVEL ASPHALT PAVEMENT OR STABILIZE A FILL

I. Equipment, materials, and personnel

A. Concrete pump with 3-inch material hoses

B. Operator's manual

C. One-and-one-half-inch injection points, 48 inches long

(NOTE: For stabilizing, also use 72-inch and 96-inch injection points.)

D. Compressor with air hose

E. Paving breaker with driving tool

F. Rock drill with 24-inch drill steel and 1 1/2-inch drill bits

G. Five-hundred gallon (minimum) water transport with water hose

H. Dump truck

I. Shovels

J. Portland cement

K. Material that will flow readily when wet, such as loamy soil or fly ash

L. Recommended safety equipment

1. Hard hat
2. Hard-toed shoes
3. Gloves
4. Respirator
5. Close-fitting clothing

M. Traffic-control devices

N. Shovel crew

O. Hose crew

P. Supervisor

II. Procedure

(NOTE: The procedures for leveling asphalt and for stabilizing fill are basically the same. Any difference will be noted.)

A. Perform all prestart inspection and maintenance procedures

B. Move equipment and materials to job site

C. Post all required traffic-control devices

D. Position equipment

(NOTE: Supervisor will mark pattern and have 2-inch holes drilled through the pavement. If stabilizing off of pavement, no drilling is required.)

E. Connect water hose to water supply and to mud-jack water pump; open water-supply valve

F. Attach injection point(s) to material hose(s)

G. Attach material hose(s) to supply valve(s) on mud jack

(NOTE: A two-way valve allowing the use of two hoses can be used with great success in both leveling and stabilizing.)

H. Have all personnel take their assigned positions

I. Perform starting procedure

J. Instruct workers to drive injection points(s) into holes

(NOTE: Supervisor will direct placement when you signal.)

K. Signal crew when you are ready to pump

L. Open water valve

M. Turn on material pump and mixer at crew's signal

N. Continue running water, pump, and mixer until hopper, cylinders, pistons, hoses, and areas to be stabilized are wet

O. Signal shovel crew to feed mixer

(NOTE: Watch slurry closely; adjust feed as needed to maintain desired slurry consistency.)

P. Adjust water supply until slurry is consistency required for desired results

JOB SHEET #6

Q. Continue mixing and pumping operation until supervisor signals to stop pumping

(NOTE: If the pump stalls or the slurry breaks out of the fill, stop pumping immediately.)

R. Shut pump down *immediately*

S. Signal workers to stop feeding hopper

T. Close water valve

(CAUTION: Never leave slurry in material hoses for long periods of time. If operation is to be delayed an hour or more, slurry should be thinned to about the consistency of water.)

U. Repeat signaling, pumping, feeding mixer, and shutting down pump as needed until job is completed

(NOTE: Supervisor will signal when pavement is level and stable, or when fill is completely stabilized.)

V. Clean unit after job is completed, or at end of work day

W. Remove hoses and store them in their proper places

X. Move equipment to next job site or park equipment in a safe place overnight

MUD JACK
UNIT IX

TEST

NAME_______________________________________ SCORE _________________

1. Match terms associated with mud jacks to their correct definitions. Write the correct numbers in the blanks.

_____a. Raising surface by forcing slurry under the slab

_____b. To inject slurry into fills, dams, or subbase to prevent further settlement or slippage

_____c. Mixture thin enough to fill all voids

_____d. Gasoline-powered pump that forces soil material mixed with water and portland cement through a hose and nozzle

_____e. Needlelike attachment for placing slurry deep (48 inches to 96 inches) under surface; used for stabilizing and for leveling asphalt pavement

_____f. Mixture thick enough to lift surface

_____g. Material created by mixing water with fine solid materials such as soil, portland cement, or fly ash

_____h. Device for plugging holes

_____i. Empty space or air pocket

1. Slurry (mud)
2. Mud jacking
3. Stabilize
4. Mud jack
5. Raising slurry
6. Void
7. Filling slurry
8. Injection point
9. Boot

2. Select from the following list uses of mud jacks in highway maintenance. Write an "X" in the blank before each correct answer.

_____a. Filling potholes

_____b. Stabilizing behind and around bridge abutments

_____c. Filling postholes and guardrail holes

_____d. Raising depressed concrete

_____e. Stabilizing fill

TEST

______f. Stabilizing pond bottoms

______g. Correcting and stabilizing settled utility trenches

______h. Raising depressed asphalt pavement

______i. Sealing concrete joints

______j. Relieving pressure in material around culverts

TEST

3. Identify the parts of a mud jack. Write the correct numbers in the blanks. This question is continued on the next page.

_____a. Slurry cylinder

_____b. Paddles

_____c. Nozzle

_____d. Pistons (2)

_____e. Tongue

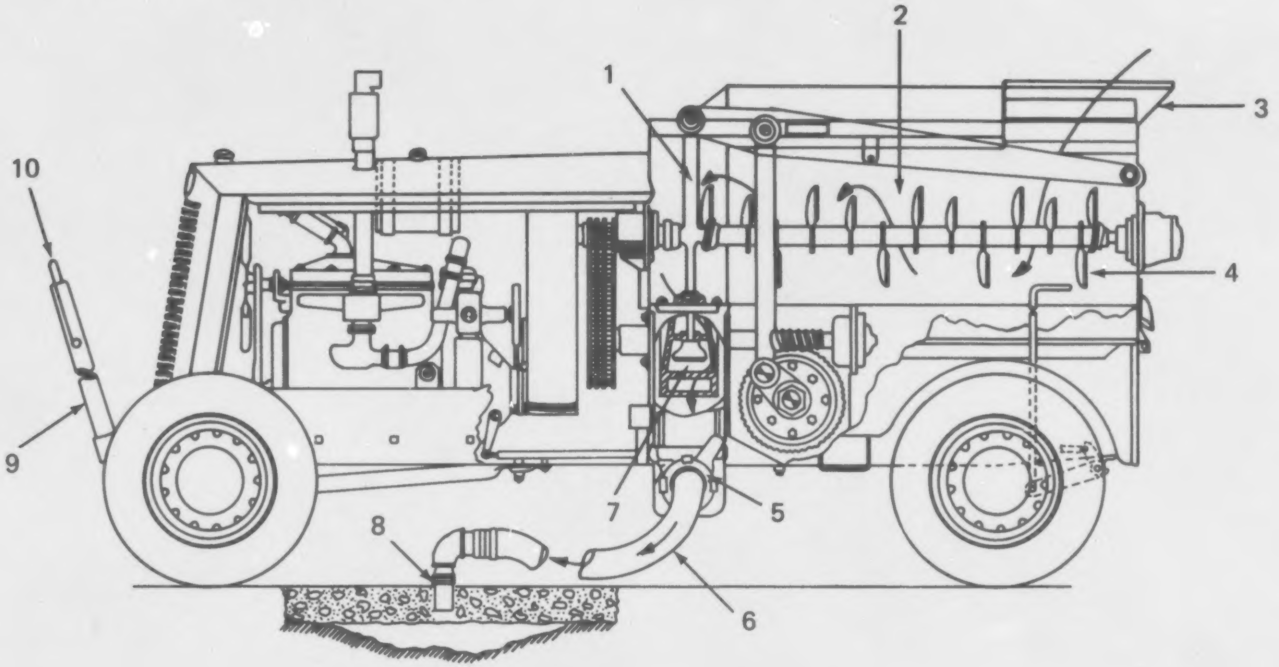
_____f. Hopper

_____g. Mixing chamber

_____h. Ball valve

_____i. Hose

_____j. Hitch



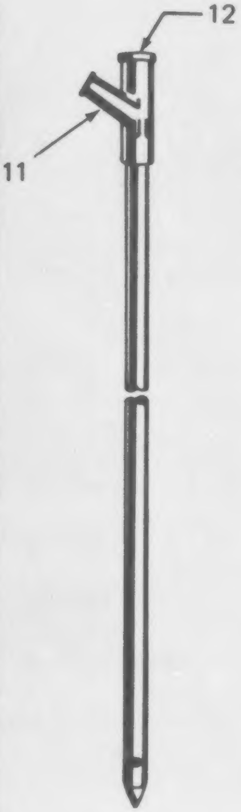
TEST

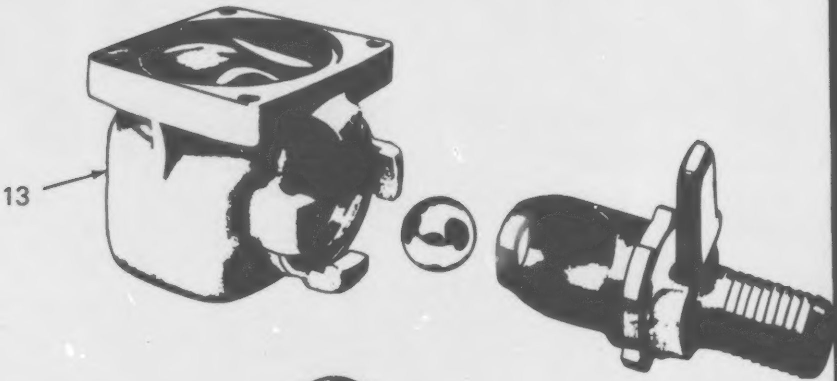
_____k. Injection-point hose shank

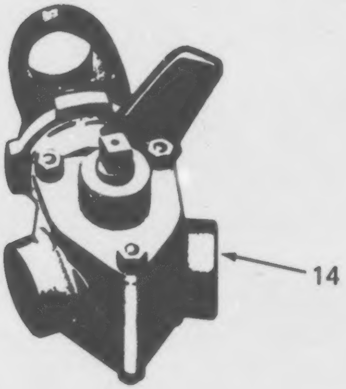
_____l. Single ball valve

_____m. Two-way valve for two hose lines

_____n. Injection-point driving socket







TEST

4. Match mud-jack controls to their proper functions. Write the correct numbers in the blanks.

_____a. Adjusts engine speed
_____b. Controls water flow into mixing chamber
_____c. Engages or disengages pump
_____d. Shuts down engine

1. Main water valve
2. Clutch
3. ON/OFF switch
4. Throttle

5. Arrange in order steps in a mud-jacking operation. Write a "1" before the first step, a "2" before the second step, and so on.

_____a. Hose crew plugs leaking hole with boot or other device
_____b. Supervisor measures raised distance at several points along string line
_____c. Mud-jack operator starts water and mixer
_____d. Pumping stops
_____e. Supervisor places string line at desired height
_____f. Hose crew moves nozzle to different hole
_____g. Operation continues until slab is level at desired height
_____h. Hose crew drills evenly spaced holes with a pneumatic rock drill
_____i. Pumping continues until surface reaches desired height or until slurry leaks out of one of the other holes
_____j. When slab approaches desired height, mud-jack operator thins material to filling-slurry consistency
_____k. Shovel crew, directed by mud-jack operator, feeds soil material mixed with portland cement into mud jack
_____l. Mud-jack operator starts pump
_____m. Hose crew fits nozzle into hole; two people stand on pad to hold it in place

6. State five safety rules for operating a mud jack.

a. ______________________________
b. ______________________________
c. ______________________________
d. ______________________________
e. ______________________________

TEST

7. State nine rules for effective mud-jack operation.

   a. ______________________________

   b. ______________________________

   c. ______________________________

   d. ______________________________

   e. ______________________________

   f. ______________________________

   g. ______________________________

   h. ______________________________

   i. ______________________________

(NOTE: Test question 8 lists the job sheets. They are an important part of this test. If they have not been completed, check with your instructor.)

8. Demonstrate the ability to

   a. Perform prestart inspection and maintenance procedures on a mud jack.

   b. Service a mud jack.

   c. Start, warm up, operate, and shut down a mud jack.

   d. Clean a mud jack.

   e. Level a concrete slab.

   f. Level asphalt pavement or stabilize a fill.

MUD JACK
UNIT IX

ANSWERS TO TEST

1. a. 2
   b. 3
   c. 7
   d. 4
   e. 8
   f. 5
   g. 1
   h. 9
   i. 6

2. b, d, e, g, h

3. a. 7
   b. 4
   c. 8
   d. 1
   e. 9
   f. 3
   g. 2
   h. 5
   i. 6
   j. 10
   k. 11
   l. 13
   m. 14
   n. 12

4. a. 4
   b. 1
   c. 2
   d. 3

5. a. 9
   b. 11
   c. 3
   d. 8
   e. 1
   f. 10
   g. 13
   h. 2
   i. 7
   j. 12
   k. 4
   l. 6
   m. 5

ANSWERS TO TEST

6. Answer should include any five of the following
   - a. Read operator's manual thoroughly: know your machine
   - b. Study departmental safety manual
   - c. Wear recommended safety equipment
   - d. Use traffic-control devices
   - e. Keep hands away from moving parts
   - f. Keep shovels and tools away from rotors
   - g. Watch footing when unit is moving and when stepping down from unit

7. Answer should include any nine of the following
   - a. Perform all prestart inspection and maintenance procedures
   - b. Park equipment on stable slab
   - c. Make sure all hose connections are secure
   - d. Make sure soil material is clean (free of grass and debris)
   - e. Check water level in the tank periodically
   - f. Operate at full throttle
   - g. Keep pumps supplied with material at all times
   - h. Adjust water and soil material as needed
   - i. Watch nozzle operators for signals
   - j. Begin operation with filling slurry, and then thicken to proper consistency
   - k. Keep raising slurry at a constant consistency
   - l. Add more water to thin slurry material when slab is within 1/8 inch of string line
   - m. Clean pump, hoses, and nozzles *thoroughly* after each use

8. Performance skills evaluated to the satisfaction of the instructor

ASPHALT LAYDOWN MACHINE
UNIT X

UNIT OBJECTIVE

After completing this unit, the student should be able to safely and effectively operate the tractor and screed on an asphalt laydown machine. This knowledge will be shown by completing job sheets and unit test with a minimum score of 85 percent.

SPECIFIC OBJECTIVES

After completing this unit, the student should be able to

1. Match terms associated with asphalt laydown machines to their correct definitions.
2. Arrange in order procedures in a laydown operation.
3. List members of a laydown team.
4. Identify parts of a typical laydown machine.
5. Match typical laydown machine controls to their correct functions.
6. Identify screed controls on a typical laydown machine.
7. Arrange in order stages in the flow of material.
8. Match systems and attachments to their correct descriptions.
9. Select from a list principles for controlling mat thickness.
10. Match adjustments for controlling mat surface quality to their correct descriptions.
11. State safety rules for operating a laydown machine.
12. Distinguish among responsibilities of laydown operator, screed operator, and dump guide.
13. State procedures for effective laydown machine operation.
14. State procedures for effective screed operation.
15. Select from a list flaws in the road surface that can be caused by poor laydown machine procedures.
16. Demonstrate the ability to
    a. Perform prestart inspection and maintenance procedures.
    b. Service an asphalt laydown machine.

OBJECTIVE SHEET

c. Start, warm up, operate, and shut down an asphalt laydown machine.

d. Heat the screed.

e. Wash down machine.

f. Adjust machine for paving.

g. Operate screed.

h. Place a 2-inch overlay.

ASPHALT LAYDOWN MACHINE
UNIT X

SUGGESTED ACTIVITIES

I. Suggested activities

   A. Order materials planned to supplement unit.

      1. Catalog--*Publications and Visual Aids.* The Asphalt Institute. Available from the Asphalt Institute, Asphalt Institute Building, College Park, Maryland 20740, 301/277-4258.

         (NOTE: This catalog lists publications, films, and slide presentations on all aspects of asphaltic materials and their application. It will be useful for all units relating to asphalt operation.)

      2. Slide-cassette presentation--*Field Placement of Signs.* Color, 40 minutes, Traffic Technician Seminar. Available from Oklahoma Department of Transportation, 200 N.E. 21, Oklahoma City, Oklahoma 73105. Order Code No. 322-79-1-6.

         (NOTE: This presentation demonstrates good sign placement and discusses placement, installation, and maintenance techniques for various signs.)

   B. Provide students with objective sheet.

   C. Provide students with information and job sheets.

   D. Discuss unit and specific objectives.

   E. Discuss information sheet.

   F. Demonstrate and discuss procedures outlined in job sheets.

   G. Provide alternate jobs if job sheets are not practical.

   H. Arrange a field trip for students to observe asphalt laydown machine operations.

   I. Discuss characteristics of emulsion and cutback asphalt materials.

   J. Review use of traffic control devices.

   K. Give test.

II. Instructional materials

   A. Objective sheet

   B. Suggested activities

   C. Information sheet

SUGGESTED ACTIVITIES

D. Job sheets

1. Job Sheet #1--Perform Prestart Inspection and Maintenance Procedures
2. Job Sheet #2--Service an Asphalt Laydown Machine
3. Job Sheet #3--Start, Warm Up, Operate, and Shut Down an Asphalt Laydown Machine
4. Job Sheet #4--Heat the Screed
5. Job Sheet #5--Wash Down Machine
6. Job Sheet #6--Adjust Machine for Paving
7. Job Sheet #7--Operate a Screed
8. Job Sheet #8--Place a 2-Inch Overlay

E. Test

F. Answers to test

III. Unit references

A. *Bituminous Construction Handbook.* Aurora, Illinois: Barber-Greene Company, 1979.

B. *Operator's Manual, Asphalt Paver AP-1100.* Oklahoma City, Oklahoma: CMI Corporation, 1978.

C. *Operator's Manual, PF-120H Bituminous Paver.* Mattoon, Illinois: Blaw-Knox Construction Equipment Inc., 1980.

D. *Operation and Service Manual, Model SB-140 Finisher.* Aurora, Illinois: Barber-Greene Company, n.d.

E. *Paving Manual: Screed Adjustments and Paving Techniques.* Mattoon, Illinois: Blaw-Knox Construction Equipment Co., n.d.

ASPHALT LAYDOWN MACHINE
UNIT X

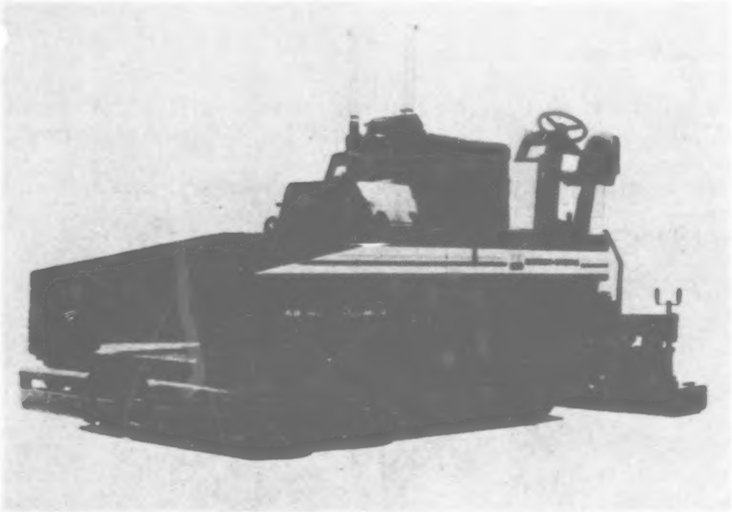
INFORMATION SHEET

I. Terms and definitions

A. Asphalt laydown machine--Machine that places and levels asphalt mat over a prepared surface (Figure 1)

EXAMPLE:

FIGURE 1



Courtesy of Barber-Greene Company.

B. Tractor--Mobile part of laydown machine; pulls screed

C. Screed--Metal plate; levels and smooths surface

D. Mat--Asphalt material laid in various thicknesses by machine

E. Tack coat--Sticky surface layer of liquid asphaltic material; prepares surface so that mat will adhere to it

F. Overlay--Thin layer of asphaltic material placed over an existing road surface

G. Material--Mixture of liquid asphalt, aggregate, and sand

H. Flow--Movement of material through laydown machine

I. Compaction--Pressing material together to increase density

J. Head of material--Material that builds up and is pushed ahead of screed

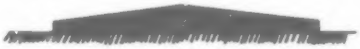
INFORMATION SHEET

K. Contour--Cross section of the surface shape

L. Crown--Raised center of pavement; slopes toward edges for drainage (Figure 2)

EXAMPLE:

FIGURE 2



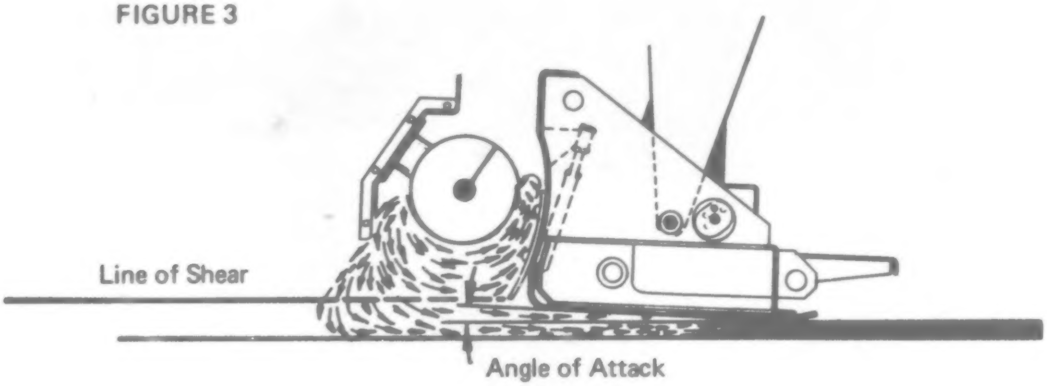
Used with permission of Barber-Greene Company.

M. Line of shear--Dividing line where material goes under screed and into mat, or up and back into auger chamber for later placement (Figure 3)

N. Angle of attack--Angle between line of shear and mat surface (Figure 3)

EXAMPLE:

FIGURE 3



Used with permission of Blaw-Knox Construction Equipment Company.

O. Starting blocks--Wood blocks 20% to 25% thicker than finished mat; used to set screed depth control

(NOTE: Additional thickness allows for compaction.)

P. Shoe--Attachment that rides on surface and registers changes in height or angle of surface

Q. Longitudinal--Along the roadway

R. Transverse--Across the roadway

INFORMATION SHEET

II. Procedures in a laydown operation

- A. Surface is prepared

  EXAMPLE: Cracks and potholes filled

- B. Screed is adjusted for proper width
- C. Asphalt distributor sprays a tack coat
- D. Laydown machine is aligned to surface the area marked
- E. Dump truck hooks to front end of laydown machine
- F. Truck feeds material into hopper
- G. Laydown machine moves forward at proper speed for desired surface

  (NOTE: Laydown machine pushes truck forward. As truck empties its load, it is replaced by another truck.)

- H. Flaws in the surface are corrected by shoveling and raking
- I. Rollers compact the new mat

III. Members of a laydown team

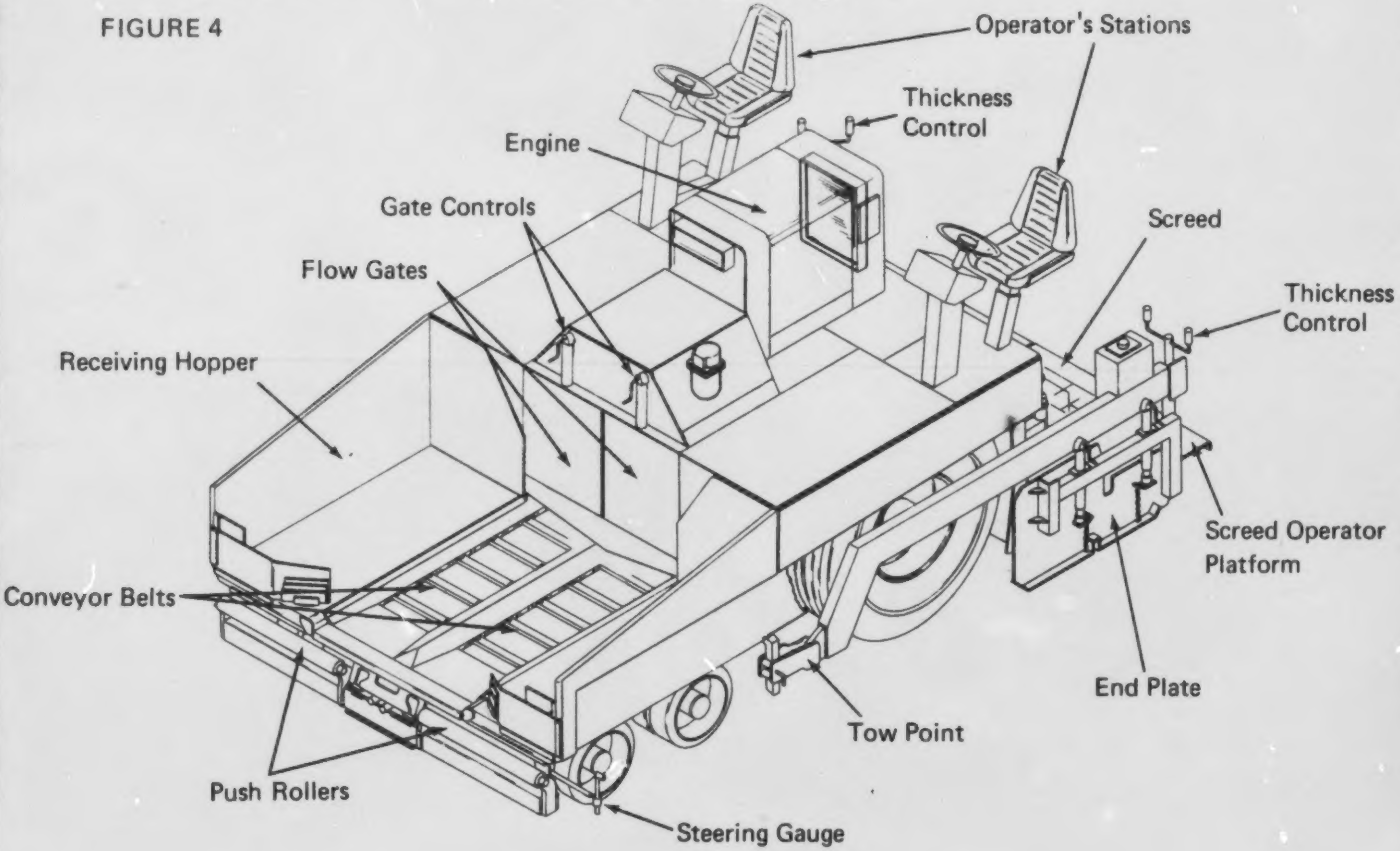
(NOTE: A laydown operation is a team effort. Everyone must work together to get a smooth, level surface. A change or error in any part of the operation will affect the other parts. Each person must watch for signals from other operators and for changes in adjustment, material, or mat surface.)

- A. Dump truck operators
- B. Laydown operator
- C. Screed operator
- D. Dump guide
- E. Shovelers and rakers
- F. Supervisor

INFORMATION SHEET

IV. Parts of a typical laydown machine (Figure 4; Job Sheets #1 and #2)

FIGURE 4


Operator's Stations
Thickness Control
Engine
Gate Controls
Screed
Flow Gates
Thickness Control
Receiving Hopper
Screed Operator Platform
Conveyor Belts
End Plate
Tow Point
Push Rollers
Steering Gauge

Used with permission of Barber-Greene Company.

INFORMATION SHEET

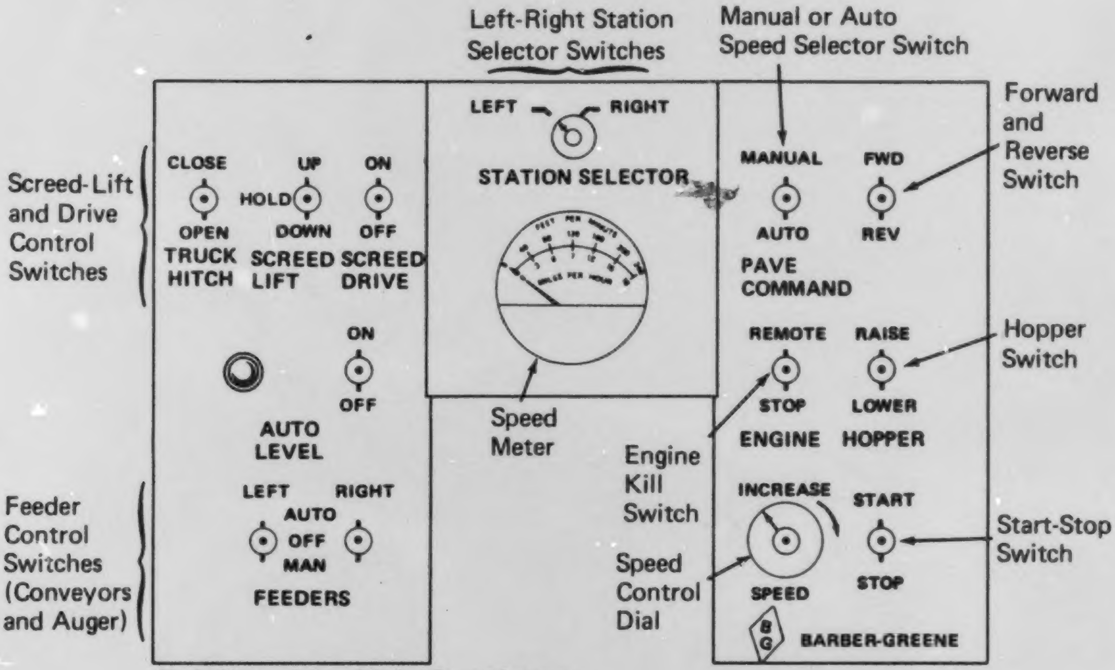
V. Typical laydown machine controls and functions (Figures 5 and 6; Job Sheet #3)

(NOTE: Controls will vary with model and manufacturer.)

EXAMPLES:

FIGURE 5

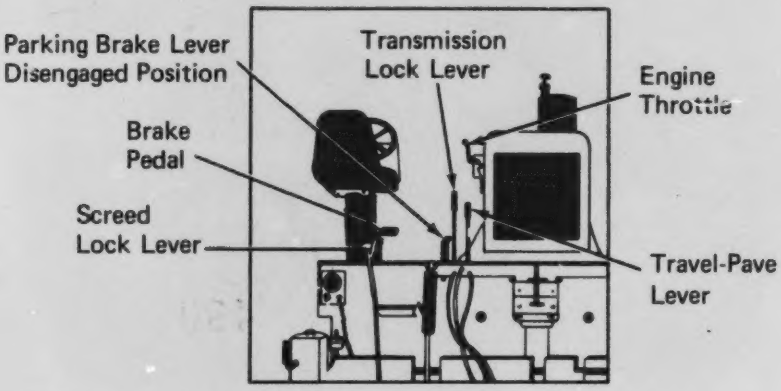
PANEL CONTROLS


Left-Right Station Selector Switches
Manual or Auto Speed Selector Switch
Forward and Reverse Switch
Screed-Lift and Drive Control Switches
CLOSE
OPEN
TRUCK HITCH
UP
HOLD
DOWN
SCREED LIFT
ON
OFF
SCREED DRIVE
LEFT
RIGHT
STATION SELECTOR
FEET PER MINUTE
MILES PER HOUR
MANUAL
AUTO
FWD
REV
PAVE COMMAND
ON
OFF
AUTO LEVEL
REMOTE
STOP
ENGINE
RAISE
LOWER
HOPPER
Hopper Switch
Speed Meter
Engine Kill Switch
Feeder Control Switches (Conveyors and Auger)
LEFT
RIGHT
AUTO
OFF
MAN
FEEDERS
INCREASE
SPEED
START
STOP
Start-Stop Switch
Speed Control Dial
BG
BARBER-GREENE

Used with permission of Barber-Greene Company.

FIGURE 6

LEVER CONTROLS


Parking Brake Lever Disengaged Position
Transmission Lock Lever
Engine Throttle
Brake Pedal
Screed Lock Lever
Travel-Pave Lever

Used with permission of Barber-Greene Company.

INFORMATION SHEET

A. Throttle--Adjusts engine speed

B. Transmission lock lever--Locks in differential for paving

C. Travel-pave lever--Selects transmission speed (gear range)

D. Parking brake lever--Secures machine when parked

(NOTE: The parking brake lever engages brake on transmission.)

E. Foot brake pedal--Stops forward or reverse motion

(NOTE: The foot brake pedal engages the wheel brakes.)

F. Screed lock lever--Supports screed for travel

G. Screed-lift control switch--Raises, holds, and lowers screed

H. Screed-drive control switch--Turns screed compacting mechanism on or off

I. Feeder control switches--Control conveyor belts and augers

J. Station selector switch--Activates left or right operator's station

K. Speed meter--Indicates speed in feet per minute

L. Speed control switch--Selects manual or automatic speed

M. Forward and reverse switch--Selects direction of travel

N. Hopper raise and lower switch--Raises and lowers hoppers

O. Speed control dial--Controls speed of machine

P. Travel and paving start-stop switch--Starts and stops machine

Q. Emergency stop button--Kills engine

R. Master clutch (not shown)--Enables cold-weather starts

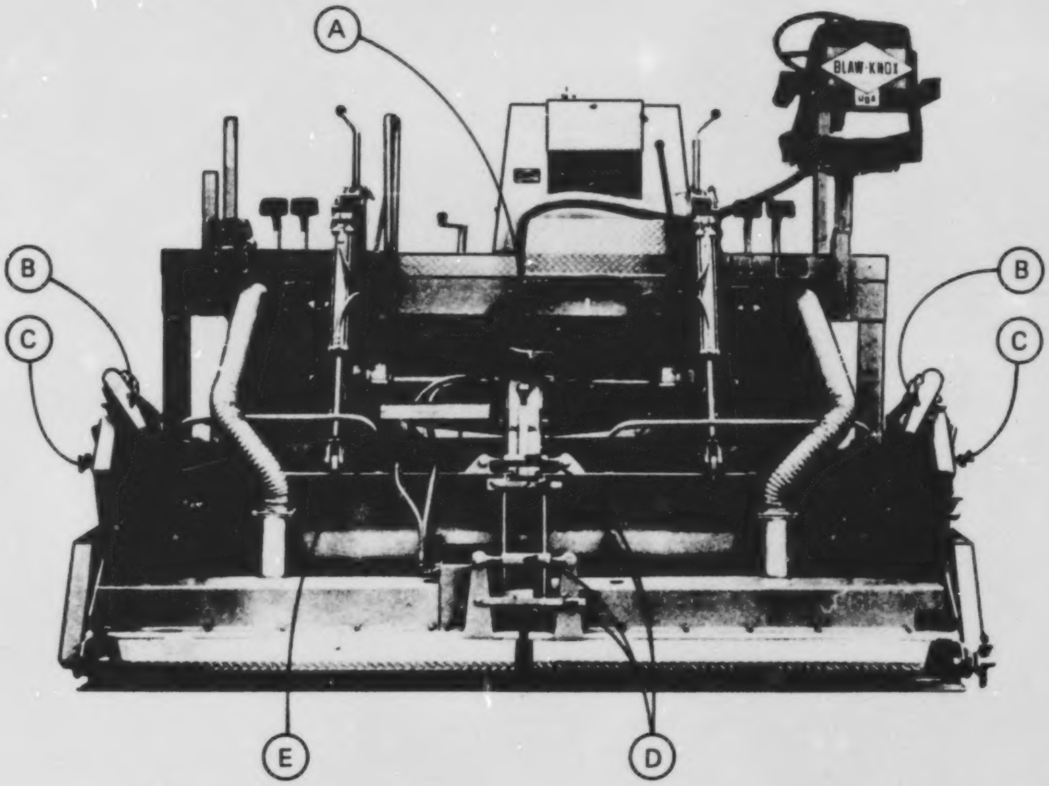
(NOTE: The master clutch is always engaged except when starting engine in cold weather.)

INFORMATION SHEET

VI. Screed controls on a typical laydown machine (Figure 7; Job Sheet #4)

(NOTE: Controls will vary with manufacturer and model.)

FIGURE 7



Used with permission of Blaw-Knox Construction Equipment Company.

A. Heater controls

(NOTE: Controls include spray valve for washdown hose, fuel valves for right-hand and left-hand screed heaters, fuel pump switch, burner switches [blowers], and ignitors.)

B. Thickness control

C. End plate control

D. Crown controls

E. Vibrator control

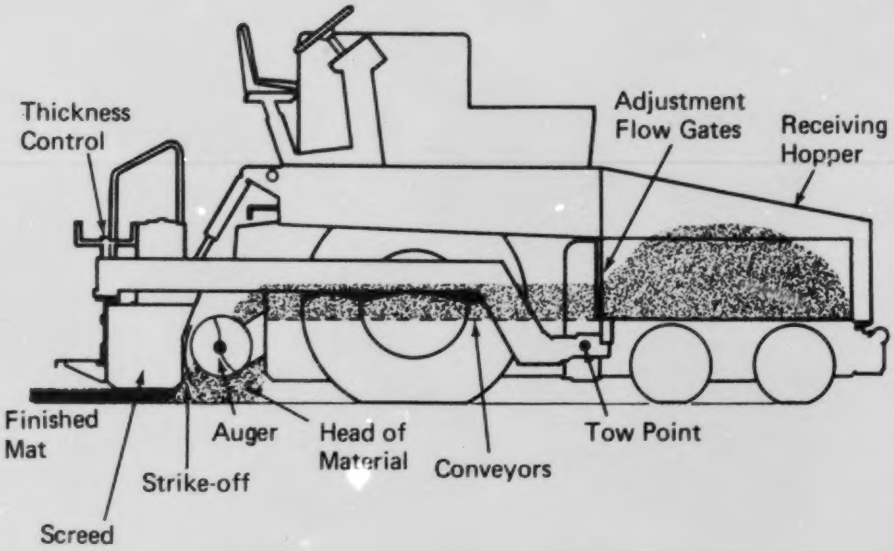
(NOTE: Control lever sets frequency. Intensity is controlled by weights.)

INFORMATION SHEET

VII. Stages in the flow of material (Figure 8)

EXAMPLE:

FIGURE 8


Thickness Control
Adjustment Flow Gates
Receiving Hopper
Finished Mat
Auger
Head of Material
Tow Point
Conveyors
Strike-off
Screed

Used with permission of Barber-Greene Company.

A. Truck dumps asphalt material into hopper

B. Conveyors move material through flow gates to auger

C. Auger turns material out onto road surface

D. Head of material builds up around auger

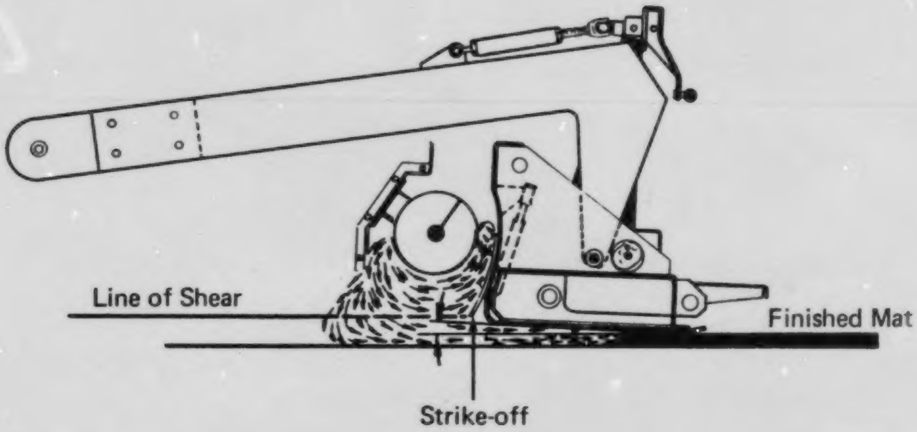
INFORMATION SHEET

E. Strike-off evens material and passes correct amount under screed (Figure 9)

(NOTE: The strike-off keeps material from balling up as it goes under the screed. It creates a "line of shear" where some material flows under the screed and the rest returns to the auger to be placed later.)

EXAMPLE:

FIGURE 9



Used with permission of Blaw-Knox Construction Equipment Company.

F. Vibrator evens flow and lightly compacts material

G. Screed bottom shapes and compacts the mat

(NOTE: Screed moves up and down and tilts to create a level surface. End plates shape the sides.)

VIII. Descriptions of systems and attachments

A. Automatic feed control--Controls conveyor speed, regulates amount of material fed to auger, and turns augers on and off as material builds up

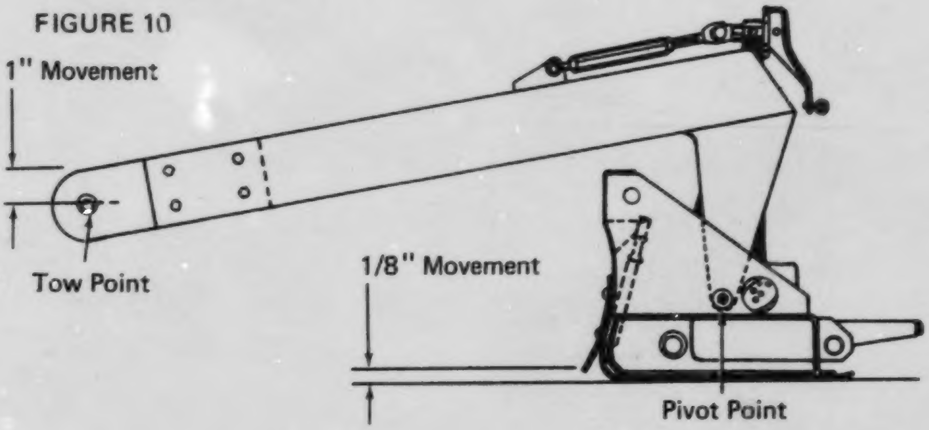
INFORMATION SHEET

B. Automatic leveler--Screed "floats" to keep mat surface level when road surface varies due to dips, high points, or ruts (Figure 10)

(NOTE: The tractor pulls the screed by two side arms attached at the tow point. The screed is attached at the pivot point. The pivot allows the screed a free-floating action that fills low points and glides over high spots, leaving a level surface. It keeps the line of travel parallel to the line of pull, so that the surface is always at the same height, even though the mat will be thicker at the low points and thinner at the high points. A shoe or ski rides on the surface to register changes.)

EXAMPLE:

FIGURE 10

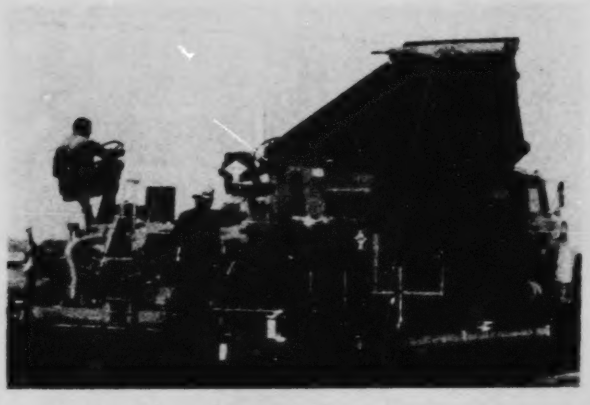


Used with permission of Blaw-Knox Construction Equipment Company.

1. Ski--Device used on first pass to bridge dips and level high places (Figure 11)

EXAMPLE:

FIGURE 11



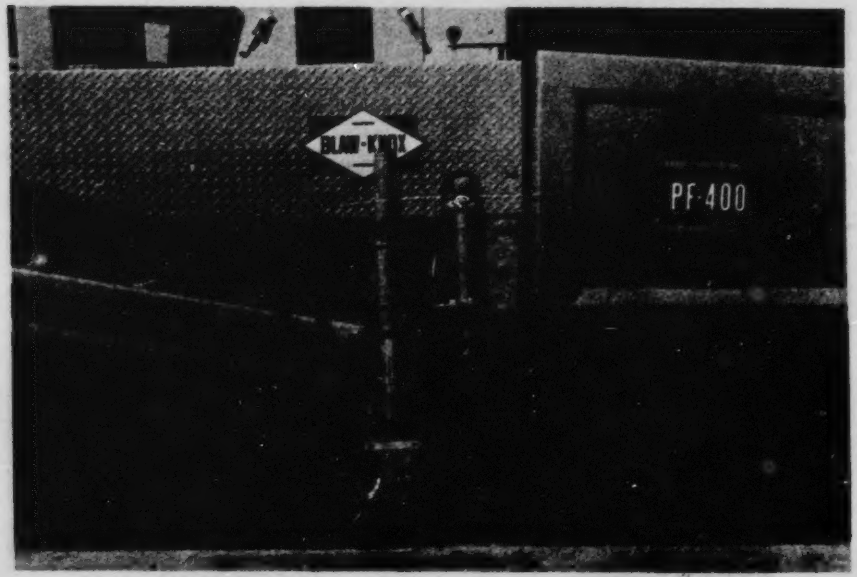
Courtesy of Blaw-Knox Construction Equipment Company.

INFORMATION SHEET

2. Matching shoe--Device used on second pass to keep surface even with mat laid on first pass (Figure 12)

EXAMPLE:

FIGURE 12



Courtesy of Blaw-Knox Construction Equipment Company.

C. Screed extension--Allows machine to lay wider mats than those possible with existing screed

(NOTE: Screed extensions come in 6-inch, 1-foot, 2-foot, and 5-foot lengths. They have an auger, auger guard, vibrator, step, strike-off, heater, and connectors for attaching to the screed.)

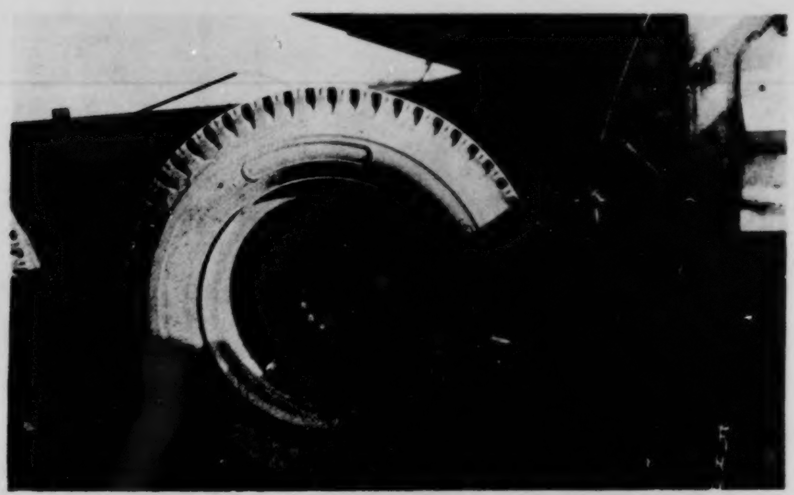
INFORMATION SHEET

D. Layton hitch--Hooks truck to laydown machine (Figure 13)

(NOTE: The hitch, or quick-coupler, extends out from both sides of the tractor in front of the push rollers. When the truck is in place, the hitch retracts and catches the inside rim of the wheel. As the tractor moves forward, a wheel on the hitch turns the truck wheel and pushes the truck forward. The Layton hitch is an option; not all machines have one.)

EXAMPLE:

FIGURE 13



IX. Principles for controlling mat thickness (Job Sheets #6 - #8)

(NOTE: Three forces affect mat thickness: forward paving speed, angle of attack, and the head of material. The head of material is the most important factor and the most difficult to control.)

A. Forward paving speed--Must be smooth and constant

(NOTE: Any interruption in paving speed will show in the riding surface.)

B. Angle of attack

1. Controlled by thickness controls on screed

2. Increasing angle will thicken mat

(NOTE: To increase the angle, turn crank counterclockwise.)

INFORMATION SHEET

3. Decreasing angle will produce a thinner mat

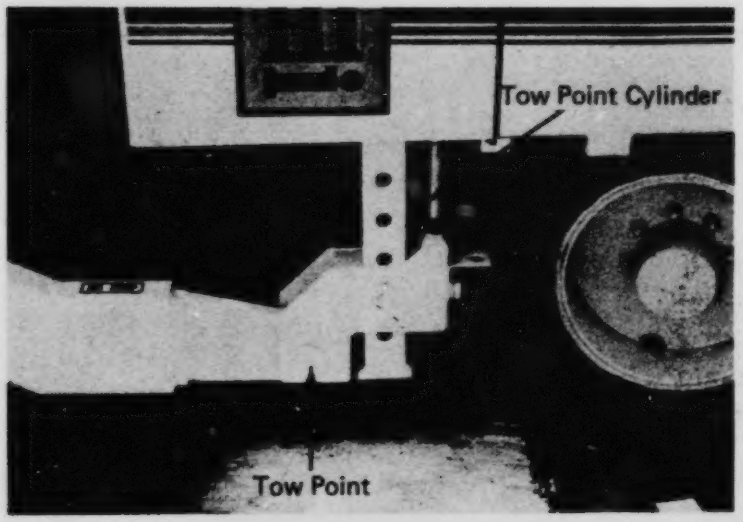
   (NOTE: To decrease the angle, turn crank clockwise.)

4. Tow point must be adjusted when using grade control or slope control

   (NOTE: Raise or lower tow point by removing pin, moving hitch bar to correct hole, and replacing pin. See Figure 14.)

   EXAMPLE:

FIGURE 14



Courtesy of CMI Corporation.

C. Head of material

1. Amount of material must be kept constant
2. Depth of material must be even along entire length of screed

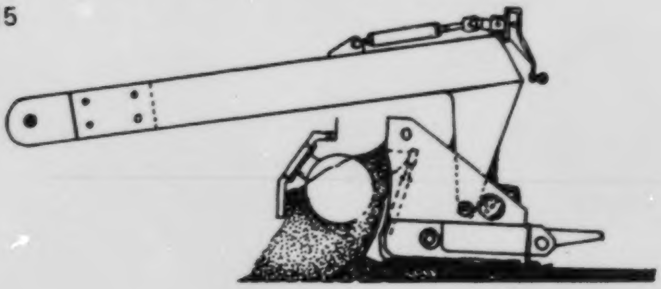
INFORMATION SHEET

3. Augers must be fed correct amount of material (Figures 15-17)

(NOTE: Overfeeding or overloading will cause ripples, auger shadows, short and long waves, and auger wear. Underfeeding or uneven flow will result in a poor riding surface.)

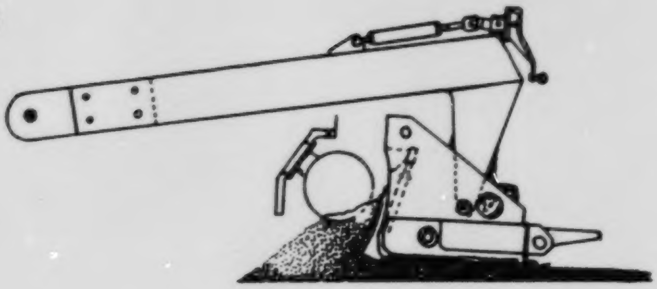
EXAMPLES:

FIGURE 15



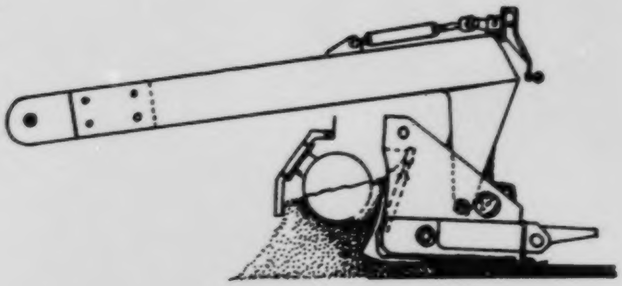
Overfeeding Augers

FIGURE 16



Underfeeding Augers

FIGURE 17



Correct Feeding

Used with permission of Blaw-Knox Construction Equipment Company.

INFORMATION SHEET

X. Adjustments for controlling mat surface quality

(NOTE: Auger and conveyor speed are adjusted by the laydown operator; crown control, vibrator speed and power, and thickness control are adjusted by the screed operator.)

A. Auger and conveyor speed--Adjust along with flow gates so that system will run 80% to 90% of the time

(NOTE: Using a higher speed than is needed can result in uneven paving, early compaction, and auger wear.)

B. Crown control--Adjust to produce desired contour

C. Vibrator speed and power--Adjust according to material and thickness

D. Thickness control--Adjust according to desired mat depth

XI. Safety rules for operating a laydown machine (Job Sheets #5 and #8)

(NOTE: Think *safety* and you will work safely.)

A. Read operator's manual thoroughly: know your machine

B. Study departmental safety manual

C. Wear protective clothing

EXAMPLES:

Laydown operator:	Goggles, close-fitting clothing, gloves, respirator if needed (for fumes), hearing protection
Screed operator:	Close-fitting clothing, insulated shoes, insulated gloves, respirator if needed (for fumes), hearing protection

D. Use traffic control devices

E. Signal other personnel before starting machine

F. Be sure that hopper, conveyors, and augers are clear of loose parts and tools before starting machine

G. Be sure all guards and shields are in place and in good working condition

H. Set hand brake before leaving operator's seat

I. Mount and dismount machine using steps, handrails, and walkways

(NOTE: It is easy to miss your footing.)

J. Guard against burns from material or machinery

K. Keep away from moving parts

INFORMATION SHEET

- L. Know and observe hand signals
- M. Do not leave engine running unattended
- N. Turn engine off before making adjustments or repairs
- O. Keep machine clean

XII. Responsibilities of laydown operator, screed operator, and dump guide

- A. Laydown operator
  1. Know tractor controls
  2. Operate Layton hitch if machine is so equipped
  3. Guide machine
  4. Control speed
  5. Activate screed vibrator
  6. Activate feeder
  7. Raise and lower hopper
  8. Signal screed operator regarding any changes
- B. Screed operator
  1. Know controls and adjustments for screed
  2. Adjust screed as necessary to maintain an even surface
  3. Set crown control
  4. Watch flow of material
  5. Check depth of material
  6. Make sure that full width distribution is obtained
  7. Signal laydown operator to stop in case of problems in material flow or screed operation
- C. Dump guide

  (NOTE: Frequently the screed operator will guide the truck in, and the laydown operator will perform the other functions of the dump guide.)

  1. Guide truck hookup
  2. Make sure that hookup is complete

INFORMATION SHEET

3. Control flow of material from truck to hopper
4. Signal truck release

XIII. Procedures for effective laydown machine operation (Job Sheets #1 and #6-#8)

A. Perform all prestart inspection and maintenance procedures

B. Learn location and function of controls

C. Make all necessary adjustments before operation

EXAMPLES: Set steering gauge, set flow gates, select gear range, lock in differential, select and hook up left or right operator's station.

D. Operate from left or right side according to job

(NOTE: Usually, the operator sits on the left side to signal the truck operator. The right side is used when laying a mat next to an existing mat or against a curb--whenever the guiding line is on the right side of the machine.)

E. Watch material flow from truck to hopper

F. Direct truck operator as needed

G. Raise hopper after truck pulls away

(NOTE: When hopper is raised, material at the sides goes to the center and onto the conveyors. Also, material will cool down if it is spread too thinly, and mixing it together will help keep it hot.)

H. Keep speed constant

I. Adjust material flow as needed

J. Keep machine aligned

(NOTE: Watch steering gauge.)

K. Watch the first several loads of material mix carefully

(NOTE: With practice, you will learn to recognize a poor mix, which can be corrected at the batch plant.)

L. Do not let truck bump machine

M. Keep operation as smooth as possible

N. Do not stop suddenly

O. Do not stop machine for long periods of time

P. Operate controls smoothly

INFORMATION SHEET

XIV. Procedures for effective screed operation (Job Sheets #6 and #7)

A. Perform all prestart inspection and maintenance procedures

B. Learn the location and function of all controls

C. Be sure all screed adjustments are made before operation begins

EXAMPLES: Preheat screed, check crown control, set vibrator speed, set grade control sensor (if needed), null screed, and set thickness.

D. Make precise adjustments after operation is underway

E. Make additional adjustments as needed during operation

(NOTE: Make as few adjustments as possible.)

F. Make small, gradual adjustments

(NOTE: All adjustments will affect the riding surface; DO NOT MAKE DRASTIC CHANGES. Adjustments will not take effect for 15 feet to 20 feet; do not readjust.)

G. Watch mat for uneven surface

H. Control mat thickness with periodic depth checks

(NOTE: Check depth several times over a length of 20 feet to 30 feet before making corrections with the thickness control. This will give an *average* depth and ensure that adjustments are not made from a high or low spot in the base.)

I. Learn how to identify surface faults and how to correct them

(NOTE: Operator's manual will list faults, causes, and corrections.)

J. Watch head of material to make sure that it is feeding correctly

K. Keep angle of attack as consistent as possible

L. Signal laydown operator when you see mat problems that cannot be corrected by adjusting screed

EXAMPLES: Uneven mix temperature, problems in the mix or aggregate, running conveyors and augers empty, over- or underfeeding, worn screed or augers, push rollers not working properly

M. Help shovel or rake as needed

N. Be prepared to relieve laydown operator when needed

INFORMATION SHEET

XV. Flaws in road surface that can be caused by poor laydown machine procedures

(NOTE: Check operator's manual for causes and corrections. Learn to recognize different kinds of surface flaws, and with experience you will be able to correct them by making the proper adjustments.)

A. Poor compaction

B. Poor surface texture

C. Tearing of mat

EXAMPLE: At center or on edges

D. Loose streak down center of mat

E. Auger shadows

F. Bright streak down center of mat

G. Ripples

H. Screed marks

I. Poor joints

J. Hairline cracks

ASPHALT LAYDOWN MACHINE
UNIT X

JOB SHEET #1--PERFORM PRESTART INSPECTION AND MAINTENANCE PROCEDURES

I. Equipment and materials

A. Asphalt laydown machine

B. Operator's manuals for paver and engine

C. Engine oil

D. Engine coolant

E. Hydraulic fluid

F. Fuel

G. Lubricants

H. Grease gun

I. Rags

II. Procedure

(NOTE: Deficiencies should be corrected immediately or reported to the proper authority. Do not operate defective equipment.)

A. Make a walk-around visual inspection for leaks and broken, worn, or missing parts

B. Check engine oil levels; add or change engine oil if necessary

C. Check engine coolant level; add or change coolant if necessary

D. Check hydraulic reservoir level; add fluid if needed

E. Check fuel level; fill tank if necessary

F. Check battery connections for tightness and corrosion

G. Check battery electrolyte level; add water if needed

H. Check air cleaner; remove and clean filter if necessary

I. Check brakes

J. Check tires

K. Clean solvent sediment bowls

JOB SHEET #1

L. Clean all grease fittings and lubricate according to manufacturer's specifications

M. Check hydraulic system for leaking lines and connections, bent or kinked lines, and lines rubbing against other parts

N. Check drive belts for tightness

O. Check electrical wire connections and insulation

P. Check gauges

Q. Check foot pedals for proper functioning

R. Check levers and controls for proper functioning

S. Remove trash

T. Check lights

U. Check safety devices

V. Check major components

  1. Check conveyor belts for proper adjustment and excessive wear
  2. Check augers for excessive wear
  3. Check bolts and fittings; tighten as necessary

ASPHALT LAYDOWN MACHINE
UNIT X

JOB SHEET #2--SERVICE AN ASPHALT LAYDOWN MACHINE

I. Equipment and materials

A. Laydown machine

B. Operator's manuals for paver and engine

C. Tool kit

D. Air supply

E. Grease gun

F. Lubricants

G. Cleaning solvent

H. Rags

I. Water

J. Engine coolant

K. Engine oil

L. Hydraulic fluid

M. Transmission fluid

N. Brake fluid

O. Tire pressure gauge

P. Fuel

II. Procedure

(NOTE: Follow departmental preventive maintenance program when servicing equipment. Refer to operator's manual for lubrication chart and for servicing specific components and attachments.)

A. Visually inspect for leaks and broken, worn, or missing parts

(NOTE: Major repairs and replacements should be reported to the proper authority and completed by a trained mechanic.)

B. Check engine oil level, filter, radiator cap, hose, and radiator; add or change engine oil if needed

JOB SHEET #2

C. Check engine coolant level, radiator cap, hose, and radiator; add or change coolant if needed

(CAUTION: Do not remove radiator cap unless engine is cool; then, open cap slowly to release pressure.)

D. Clean air filter; replace if necessary

E. Check fuel level, fuel filters, and sediment bowl (where applicable); fill fuel tank

F. Check battery electrolyte level, battery cables, and connectors; add water or electrolyte if necessary

(NOTE: Keep sparks and fire away from battery.)

G. Check exhaust system for loose connections and holes

H. Check hydraulic fluid level, filters, hose, lines, and fittings; look for leaks; add fluid if required

I. Check transmission fluid level; add fluid if needed

J. Check transmission pressure line filter and breather

K. Check brake adjustment and condition; adjust if necessary

L. Check brake master cylinder fluid level; fill if necessary

M. Check clutch adjustment; adjust if necessary

N. Check drive belts for tension and wear; adjust or replace if necessary

O. Check wiring, insulation, and connections

P. Clean and lubricate all grease fittings according to manufacturer's recommendations

Q. Check condition of tires

R. Check tire pressure; inflate tires to recommended pressure if necessary

S. Check all safety devices; repair if necessary

T. Check bolts and fittings; tighten as needed

U. Check major components and/or accessories

V. Check hand brakes for proper adjustment

W. Check conveyor belts for proper adjustment and wear; adjust as needed

JOB SHEET #2

X. Check augers for alignment and wear; adjust as needed

Y. Check pump drive box oil level; add oil if necessary

Z. Check auger-conveyor drive chain for proper tension; adjust as needed

ASPHALT LAYDOWN MACHINE
UNIT X

JOB SHEET #3--START, WARM UP, OPERATE, AND SHUT DOWN AN ASPHALT LAYDOWN MACHINE

I. Equipment and materials

- A. Asphalt laydown machine
- B. Operator's manual

II. Procedure

- A. Complete all prestart inspection and maintenance procedures
- B. Be sure nothing is lying on conveyor belts
- C. Mount machine using steps and handrails
- D. Read operator's manual for specific instructions for your machine
- E. Locate all controls
- F. Set parking brake if not already set
- G. Be sure all controls are in NEUTRAL or OFF position
- H. Start engine

  (NOTE: Check manual for manufacturer's procedures for cold-weather starting. Locate master clutch. Locate emergency engine shutoff.)

  1. Turn ignition switch to ON
  2. Activate station selector switch for left- and right-side operation
  3. Set throttle to idle (half open)
  4. Engage starter until engine starts
- I. Let engine warm up for a minimum of five minutes
- J. Check oil pressure for manufacturer's recommended pressure range
- K. Check voltmeter for manufacturer's recommended voltage
- L. Check to be sure that all other gauges and instruments are working properly
- M. Set speed range in LOW or PAVE position

JOB SHEET #3

N. Set throttle to fully open

O. Release parking brake

P. Set differential lock (shift) lever to LOCK or PAVE

Q. Place forward-reverse lever in FORWARD position to start forward movement

(NOTE: Some models are equipped with a switch to start movement.)

R. Set speed control

(NOTE: On some machines, speed is controlled by the forward-reverse lever. Speed increases as you move the lever away from NEUTRAL.)

S. Practice guiding machine

T. Slow down by moving speed selector to zero, or by pulling direction-speed lever toward you

(NOTE: Check operator's manual.)

U. Stop paver by using one of the following methods

1. Move travel switch to STOP
2. Move direction-speed control lever to NEUTRAL
3. Depress foot brake

(NOTE: On most pavers, the brake pedals are for emergency stops, short stops at slow speeds, or for assisting turns. Decrease engine speed rather than using the brakes when possible.)

V. Operate controls

1. Extend and retract truck hook
2. Open and close hopper
3. Activate conveyors
4. Activate auger
5. Raise and lower screed
6. Activate screed

W. Shift into reverse and practice backing machine

(CAUTION: Bring machine to a complete stop before shifting direction or shifting range.)

JOB SHEET #3

X. Stop machine; shift transmission speed to HIGH (TRAVEL)

Y. Set differential lock (shift) to UNLOCK or TRAVEL

Z. Practice operating at higher speeds

AA. Practice turning

BB. Stop machine

III. Shutdown procedure

A. Set speed control at zero or place directional-speed control lever in NEUTRAL

B. Set speed range selector at LOW

C. Set travel switch, if machine is so equipped, at STOP

D. Lower screed to ground

E. Lower hopper wings to lower limit

F. Set all switches at OFF

G. Set parking brake at ON

H. Run the engine at half speed for five minutes

(NOTE: This procedure allows the engine to cool gradually and prevents loss of coolant.)

I. Reduce engine speed to low idle for thirty seconds

J. Turn ignition switch to OFF

ASPHALT LAYDOWN MACHINE
UNIT X

JOB SHEET #4--HEAT THE SCREED

I. Equipment and materials

- A. Laydown machine
- B. Operator's manual

II. Procedure

- A. Read operator's manual thoroughly

  (NOTE: Procedures will vary with model and manufacturer. On models equipped with a glow plug, you will have to start the engine before lighting burners.)

- B. Check fuel valves; be sure that they are off
- C. Switch on fuel pump and blowers and let them run for one minute

  (NOTE: This procedure will blow out any gas that may be present.)

- D. Turn blowers off
- E. Open left-hand burner fuel valve

  (NOTE: Check operator's manual. Glow plugs must warm up before fuel valve is opened.)

- F. Engage ignition
- G. Hold ignition on until burner ignites and burns steadily
- H. Switch on blower
- I. Adjust air baffle or damper as needed for best fuel-air mixture

  (NOTE: If you hear a popping sound, open damper. More air is needed for efficient burning. Flame should burn mostly blue with a yellow tip. Too much yellow means too much air; no yellow means too little air.)

- J. Tighten wing nut to secure baffle in position if machine is so equipped
- K. Repeat procedure on right-hand burner and all additional burners if screed extensions are used
- L. Allow screed to heat for ten to fifteen minutes

  (CAUTION: If burners should go out, do not relight until excess fuel is removed from burner chamber and surrounding areas.)

JOB SHEET #4

M. Close fuel valves

N. Allow blowers to operate for ten minutes to prevent heat from damaging machine parts

O. Close down blowers

P. Regrease vibrator drive shaft bearing and U-joint bearings immediately

ASPHALT LAYDOWN MACHINE
UNIT X

JOB SHEET #5--WASH DOWN MACHINE

I. Equipment and materials

A. Laydown machine

B. Operator's manual

C. Spray hose and gun

D. Long-handled scraper

E. Solvent--Kerosene or diesel fuel in screed tank

II. Procedure

(NOTE: Machine must be cleaned as soon as paving is completed. Do not allow material to harden. Clean any part of the machine that comes into contact with the asphalt mix.)

(CAUTION: Keep spray away from tires, hydraulic hoses, electrical connections, electrical cables, etc.)

A. Read operator's manual thoroughly

B. Locate all controls before starting

C. Drive paver away from freshly laid mat onto level surface

D. Raise screed to travel position

E. Leave engine running at idle

F. Raise hoppers and remove all excess material

G. Make sure valves on all screed heaters are turned off

H. Turn on pump

I. Turn on blower

J. Open solvent spray valve

K. Clean rollers so they turn freely

(NOTE: Always start at front and work toward rear.)

L. Clean hopper; use scraper where necessary

M. Scrape down conveyor chain and guard underdeck

JOB SHEET #5

N. Wash down all surfaces

(CAUTION: Do not run conveyors while cleaning hopper and chain.)

O. Turn on conveyors

P. Spray each chain and bar thoroughly several times

Q. Turn off conveyor

R. Clean conveyor drive sprockets

S. Clean end plates so that they slide up and down properly

(NOTE: Inside surface should be smooth.)

T. Scrape out around auger bearings and wash down

U. Turn on augers

V. Wash down augers

W. Turn off augers

X. Scrape off any material caught on screed frame and screed plate

(NOTE: The face and bottom of the screed should be thoroughly cleaned.)

Y. Clean screed extensions thoroughly if machine is so equipped

(NOTE: Pay special attention to slide surfaces that mate. Grease slides after cleaning.)

Z. Shut down spray valve

AA. Turn off blower

BB. Shut down pump

CC. Store hose and gun in designated place

ASPHALT LAYDOWN MACHINE
UNIT X

JOB SHEET #6--ADJUST MACHINE FOR PAVING

I. Equipment and materials

A. Asphalt laydown machine

B. Operator's manual

C. Starting blocks, at least 2 feet long and 20% to 25% higher than desired pavement depth

II. Procedure

A. Read operator's manual thoroughly

B. Locate all controls and gauges

C. Light heaters and preheat screed

D. Position paver at joint or starting point

E. Raise screed

F. Place starting blocks under screed at both ends

(NOTE: Be sure blocks reach from front to back of screed.)

G. Null screed by lowering it until both cranks turn freely in either direction

(NOTE: Hold LOWER switch or lever down for a few seconds after screed touches blocks to make sure that the full weight of the screed is on the blocks.)

H. Set angle of attack by turning the depth control cranks one-quarter to one-half turn on both sides

(NOTE: Precise angle of attack is set after paving is underway. In most cases, once the angle is set, very little adjustment is needed.)

I. Consult operator's manual; set steering guide at edge of paving lane or other marker

J. Consult operator's manual; adjust automatic feeder system to control head of material

K. Consult operator's manual; set automatic leveler

L. Consult operator's manual; set screed position if not already set

ASPHALT LAYDOWN MACHINE
UNIT X

JOB SHEET #7--OPERATE SCREED

I. Equipment, materials, and personnel

  A. Asphalt laydown machine

  B. Operator's manual

  C. Hot mix material

  D. Recommended safety equipment

    1. Insulated shoes

    2. Insulated rubber gloves

    3. Close-fitting clothing

    4. Hard hat

    5. Goggles

    6. Respirator

    7. Fire extinguisher

  E. Laydown operator

II. Procedure

  A. Read and study operator's manual thoroughly

  B. Perform all prestart inspection and maintenance procedures

  (NOTE: Make visual check, and make minor adjustments and repairs as needed.)

  C. Set screed at correct angle of attack

  D. Check strike-off for correct placement

  E. Light heaters and preheat screed

  (NOTE: Check operator's manual for lighting and shutdown procedure.)

  F. As paver begins to lay mat or overlay, watch for signs of poor adjustment and make corrections as needed

  G. Check depth periodically

JOB SHEET #7

H. Use depth control crank to change tilt or angle of attack

(NOTE: Turn crank clockwise to increase angle of attack and mat thickness; turn crank counterclockwise to decrease angle and mat thickness.)

I. Continue to watch mat surface and make adjustments as needed to maintain good surface quality

J. Shut off heaters according to operator's manual

ASPHALT LAYDOWN MACHINE
UNIT X

JOB SHEET #8--PLACE A 2-INCH OVERLAY

I. Equipment, materials, and personnel

   A. Asphalt laydown machine

   B. Operator's manual

   C. Dump trucks

   D. Square-bladed shovels

   E. Asphalt rakes

   F. Hot mix material

   G. Traffic control devices

   H. Recommended safety equipment

      1. Insulated rubber gloves

      2. Hard hat

      3. Insulated shoes

      4. Close-fitting clothing

      5. Goggles

      6. Respirator

      7. Fire extinguisher

   I. Screed operator

   J. Dump guide

   K. Four laborers, minimum

II. Procedure

   A. Read and study operator's manual thoroughly

   B. Perform all prestart inspection and maintenance procedures

   (NOTE: Make visual inspection, and make needed minor repairs and adjustments.)

   C. Make sure that screed will lay a mat 12 feet wide

   (NOTE: Add screed extensions if needed.)

JOB SHEET #8

D. Make sure all traffic control devices are in place before starting operation

E. Start laydown machine and let it warm up

F. Position laydown machine at starting point

G. Make necessary adjustments

H. Signal screed operator to adjust and preheat screed

I. Lower screed until all hydraulic pressure is relieved

J. Check with screed operator to make sure that screed assembly has been properly set for paving

K. Set flow gates at center of adjustment range

L. Check steering guide or stringline for placement

M. Signal for loaded truck to back up to rollers

N. Fill hopper and activate conveyors, allowing them to run until conveyor system is full and shuts off automatically

O. Set shift lever to PAVE and turn on vibrators

(NOTE: Check operator's manual for shift lever position.)

P. Move control levers forward until paving speed is reached

Q. Maintain a constant speed and follow the steering guide

R. Make adjustments as needed to maintain correct depth and profile of mat

S. Check with screed operator as work continues

T. At end of section to be paved, raise screed to travel height and move to opposite lane

U. Position paver so that screed overlaps overlay about 1 inch

V. Repeat steps M through S, using inside edge of overlay for steering guide

W. At end of section, raise screed to travel height and move paver to clean-up site

X. Follow clean-up and shutdown procedures

Y. Move paver to storage or to next job site

ASPHALT LAYDOWN MACHINE
UNIT X

TEST

NAME ______________________________ SCORE ______________

1. Match terms associated with asphalt laydown machines to their correct definitions. Write the correct numbers in the blanks. Definitions are continued on the next page.

_____ a. Pressing material together to increase density

_____ b. Angle between line of shear and mat surface

_____ c. Mobile part of the laydown machine; pulls screed

_____ d. Raised center of pavement; slopes toward edges for drainage

_____ e. Asphalt material laid in various thicknesses by machine

_____ f. Dividing line where material goes under screed and into mat, or up and back into auger chamber for later placement

_____ g. Machine that places and levels asphalt mat over a prepared surface

_____ h. Sticky surface layer of liquid asphaltic material; prepares surface so that mat will adhere to it

_____ i. Mixture of liquid asphalt, aggregate, and sand

_____ j. Material that builds up and is pushed ahead of screed

_____ k. Along the roadway

_____ l. Metal plate; levels and smooths surface

_____ m. Movement of material through laydown machine

_____ n. Across the roadway

_____ o. Attachment that rides on surface and registers changes in height or angle of surface

1. Line of shear
2. Material
3. Asphalt laydown machine
4. Mat
5. Compaction
6. Angle of attack
7. Tack coat
8. Screed
9. Head of material
10. Crown
11. Tractor
12. Longitudinal
13. Overlay
14. Transverse
15. Starting blocks
16. Flow
17. Shoe
18. Contour

TEST

_____p. Cross section of the surface shape

_____q. Thin layer of asphaltic material placed over an existing road surface

_____r. Wood blocks 20% to 25% thicker than finished mat; used to set screed depth control

2. Arrange in order procedures in a laydown operation. Write a "1" in the blank before the first procedure, a "2" before the second, and so on.

_____a. Flaws in surface are corrected by shoveling and raking

_____b. Truck feeds material into hopper

_____c. Laydown machine is aligned to surface the area marked

_____d. Rollers compact the new mat

_____e. Surface is prepared

_____f. Laydown machine moves forward at proper speed for desired surface

_____g. Dump truck hooks to front end of laydown machine

_____h. Asphalt distributor sprays a tack coat

_____i. Screed is adjusted for proper width

3. List members of a laydown team.

a. ____________________

b. ____________________

c. ____________________

d. ____________________

e. ____________________

f. ____________________

TEST

4. Identify parts of a typical laydown machine. Write the correct numbers in the blanks.

_____a. Engine

_____b. End plate

_____c. Push rollers

_____d. Conveyor belts

_____e. Gate controls

_____f. Thickness control

_____g. Tow point

_____h. Screed operator platform

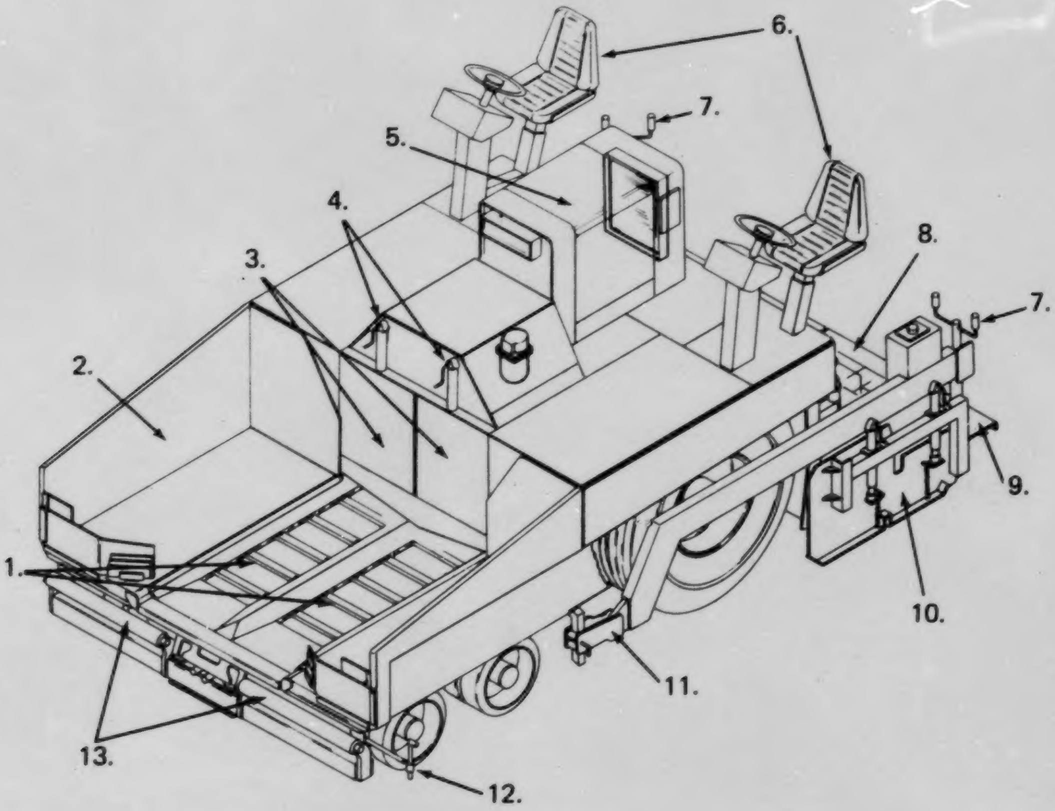
_____i. Steering gauge

_____j. Screed

_____k. Operator's stations

_____l. Receiving hopper

_____m. Flow gates



TEST

5. Match typical laydown machine controls to their correct functions. Write the correct numbers in the blanks.

_____a. Selects manual or automatic speed

_____b. Turns screed compacting mechanism on or off

_____c. Starts and stops machine

_____d. Adjusts engine speed

_____e. Secures machine when parked

_____f. Control conveyor belts and augers

_____g. Kills engine

_____h. Enables cold-weather starts

_____i. Locks in differential for paving

_____j. Stops forward or reverse motion

_____k. Raises, holds, and lowers screed

_____l. Selects direction of travel

_____m. Controls speed of machine

_____n. Activates left or right operator's station

_____o. Supports screed for travel

_____p. Raises and lowers hoppers

_____q. Selects transmission speed (gear range)

_____r. Indicates speed in feet per minute

1. Screed lock lever
2. Master clutch
3. Screed-lift control switch
4. Feeder control switches
5. Forward and reverse switch
6. Throttle
7. Hopper raise and lower switch
8. Transmission lock lever
9. Emergency stop button
10. Station selector switch
11. Speed control switch
12. Foot brake pedal
13. Speed control dial
14. Screed-drive control switch
15. Parking brake lever
16. Travel-pave lever
17. Speed meter
18. Travel and paving start-stop switch

TEST

6. Identify screed controls on a typical laydown machine. Write the correct numbers in the blanks.

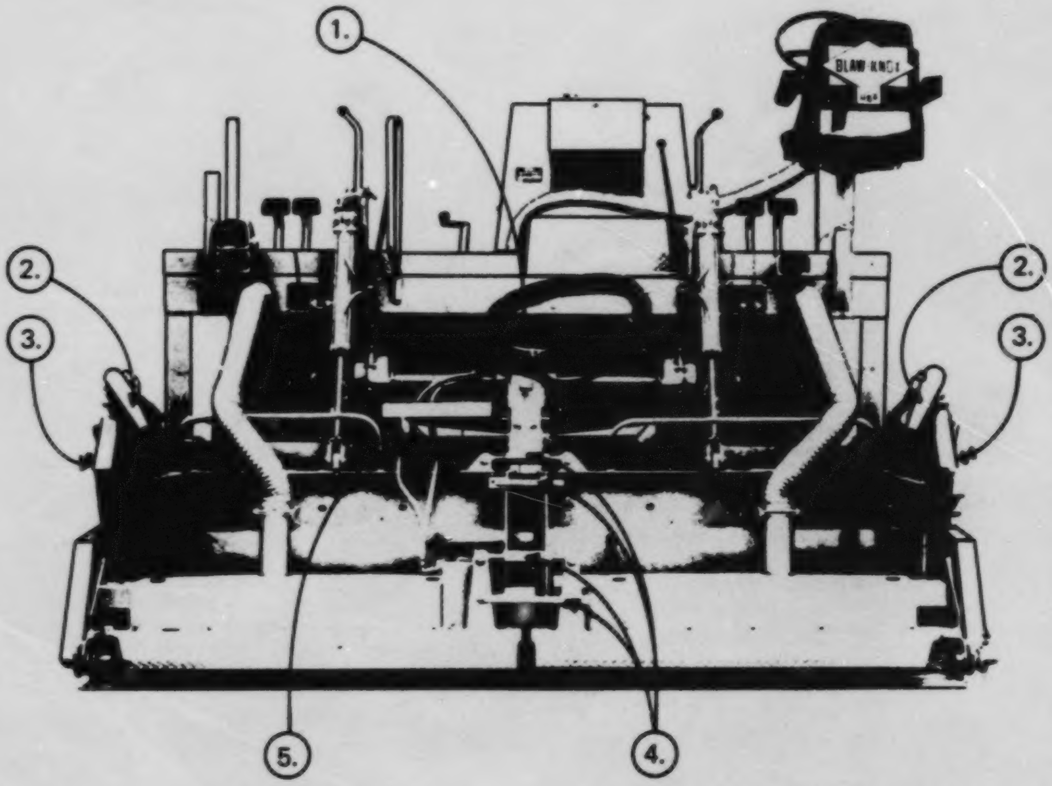
______a. Thickness control

______b. Vibrator control

______c. Crown controls

______d. Heater controls

______e. End plate control



TEST

7. Arrange in order stages in the flow of material. Write a "1" in the blank before the first stage, a "2" before the second stage, and so on.

______a. Head of material builds up around auger

______b. Screed bottom shapes and compacts the mat

______c. Truck dumps asphalt material into hopper

______d. Auger turns material out onto road surface

______e. Strike-off evens material and passes correct amount under screed

______f. Conveyors move material through flow gates to auger

______g. Vibrator evens flow and lightly compacts material

8. Match systems and attachments to their correct descriptions. Write the correct numbers in the blanks.

______a. Hooks truck to laydown machine

______b. Screed "floats" to keep mat surface level When road surface varies due to dips, high points, or ruts

______c. Allows machine to lay wider mats than those possible with existing screed

______d. Controls conveyor speed, regulates amount of material fed to auger, and turns augers on and off as material builds up

______e. Device used on first pass to bridge dips and level high places

______f. Device used on second pass to keep surface even with mat laid on first pass

1. Screed extension
2. Automatic leveler
3. Automatic feed control
4. Layton hitch
5. Matching shoe
6. Ski

9. Select from the following list principles for controlling mat thickness. Write an "X" in the blank before each correct answer.

a. Forward paving speed

______ 1) Must vary with the contour

______ 2) Must be smooth and constant

______ 3) Must be adjusted as needed for correct mat thickness

b. Angle of attack

______ 1) Increasing angle will produce a thinner mat

______ 2) Decreasing angle will produce a thinner mat

TEST

______ 3) Controlled by thickness controls on screed

______ 4) Tow point must be adjusted when using grade control or slope control

______ 5) Tow point must be adjusted when changing angle of attack

______ 6) Decreasing the angle will thicken the mat

______ 7) Increasing angle will thicken mat

c. Head of material

______ 1) Augers must be fed correct amount of material

______ 2) Amount of material varies according to condition of surface

______ 3) Depth of material must be even along entire length of screed

______ 4) Amount of material must be kept constant

______ 5) Augers must operate 100% of the time

10. Match adjustments for controlling mat surface quality to their correct descriptions. Write the correct numbers in the blanks.

______a. Adjust according to desired mat depth

______b. Adjust to produce desired contour

______c. Adjust according to material and thickness

______d. Adjust along with flow gates so that system will run 80% to 90% of the time

1. Auger and conveyor speed
2. Crown control
3. Thickness control
4. Vibrator speed and power

11. State ten safety rules for operating a laydown machine.

a. ______________________________

b. ______________________________

c. ______________________________

d. ______________________________

e. ______________________________

f. ______________________________

g. ______________________________

h. ______________________________

i. ______________________________

j. ______________________________

TEST

12. Distinguish among responsibilities of laydown operator, screed operator, and dump guide. Write an "S" in the blanks before responsibilities of the screed operator, an "L" before responsibilities of the laydown operator, and a "D" before responsibilities of the dump guide.

_____ a. Signal laydown operator to stop in case of problems in material flow or screed operation

_____ b. Guide truck hookup

_____ c. Make sure that full width distribution is obtained

_____ d. Activate screed vibrator

_____ e. Activate feeder

_____ f. Signal truck release

_____ g. Check depth of material

_____ h. Know tractor controls

_____ i. Watch flow of material

_____ j. Operate Layton hitch if machine is so equipped

_____ k. Control flow of material from truck to hopper

_____ l. Set crown control

_____ m. Know controls and adjustments for the screed

_____ n. Raise and lower hopper

_____ o. Control speed

_____ p. Make sure that hookup is complete

_____ q. Guide machine

_____ r. Adjust screed as necessary to maintain an even surface

_____ s. Signal screed operator regarding any changes

13. State twelve procedures for effective laydown machine operation.

a. ______________________________

b. ______________________________

c. ______________________________

d. ______________________________

e. ______________________________

TEST

f. ______________________________

g. ______________________________

h. ______________________________

i. ______________________________

j. ______________________________

k. ______________________________

l. ______________________________

14. State ten procedures for effective screed operation.

a. ______________________________

b. ______________________________

c. ______________________________

d. ______________________________

e. ______________________________

f. ______________________________

g. ______________________________

h. ______________________________

i. ______________________________

j. ______________________________

15. Select from the following list flaws in the road surface that can be caused by poor laydown machine procedures. Write an "X" in the blank before each correct answer.

_____a. Potholes

_____b. Ripples

_____c. Compaction of edges

_____d. Hairline cracks

_____e. Loose streak down center of mat

_____f. Roller marks

TEST

_____g. Screed marks

_____h. Poor compaction

_____i. Oversize aggregate in material

_____j. Bits of loose material on the surface

_____k. Auger shadows

_____l. Poor joints

_____m. Poor quality hot mix material

_____n. Bright streak down center of mat

_____o. Settling of mat before compaction

_____p. Tearing of mat

_____q. Poor surface texture

(NOTE: Question 16 lists the job sheets. They are an important part of this test. If they have not been completed, check with your instructor.)

16. Demonstrate the ability to

    a. Perform prestart inspection and maintenance procedures.

    b. Service an asphalt laydown machine.

    c. Start, warm up, operate, and shut down an asphalt laydown machine.

    d. Heat the screed.

    e. Wash down machine.

    f. Adjust machine for paving.

    g. Operate screed.

    h. Place a 2-inch overlay.

ASPHALT LAYDOWN MACHINE
UNIT X

ANSWERS TO TEST

1. a. 5
   b. 6
   c. 11
   d. 10
   e. 4
   f. 1
   g. 3
   h. 7
   i. 2
   j. 9
   k. 12
   l. 8
   m. 16
   n. 14
   o. 17
   p. 18
   q. 13
   r. 15

2. a. 8
   b. 6
   c. 4
   d. 9
   e. 1
   f. 7
   g. 5
   h. 3
   i. 2

3. a. Dump truck operators
   b. Laydown operator
   c. Screed operator
   d. Dump guide
   e. Shovelers and rakers
   f. Supervisor

4. a. 5
   b. 10
   c. 13
   d. 1
   e. 4
   f. 7
   g. 11
   h. 9
   i. 12
   j. 8
   k. 6
   l. 2
   m. 3

ANSWERS TO TEST

5. a. 11
b. 14
c. 18
d. 6
e. 15
f. 4
g. 9
h. 2
i. 8
j. 12
k. 3
l. 5
m. 13
n. 10
o. 1
p. 7
q. 16
r. 17

6. a. 2
b. 5
c. 4
d. 1
e. 3

7. a. 4
b. 7
c. 1
d. 3
e. 5
f. 2
g. 6

8. a. 4
b. 2
c. 1
d. 3
e. 6
f. 5

9. a. 2
b. 2, 3, 4, 7
c. 1, 3, 4

10. a. 3
b. 2
c. 4
d. 1

ANSWERS TO TEST

11. Answer should include any ten of the following

    a. Read operator's manual thoroughly: know your machine

    b. Study departmental safety manual

    c. Wear protective clothing

    d. Use traffic control devices

    e. Signal other personnel before starting machine

    f. Be sure that hopper, conveyors, and augers are clear of loose parts and tools before starting machine

    g. Be sure all guards and shields are in place and in good working condition

    h. Set hand brake before leaving operator's seat

    i. Mount and dismount machine using steps, handrails, and walkways

    j. Guard against burns from material or machinery

    k. Keep away from moving parts

    l. Know and observe hand signals

    m. Do not leave engine running unattended

    n. Turn engine off before making adjustments or repairs

    o. Keep machine clean

12. a. S
    b. D
    c. S
    d. L
    e. L
    f. D
    g. S
    h. L
    i. S
    j. L
    k. D
    l. S
    m. S
    n. L
    o. L
    p. D
    q. L
    r. S
    s. L

13. Answer should include any twelve of the following

    a. Perform all prestart inspection and maintenance procedures

    b. Learn location and function of controls

    c. Make all necessary adjustments before operation

ANSWERS TO TEST

d. Operate from left or right side according to job

e. Watch material flow from truck to hopper

f. Direct truck operator as needed

g. Raise hopper after truck pulls away

h. Keep speed constant

i. Adjust material flow as needed

j. Keep machine aligned

k. Watch the first several loads of material mix carefully

l. Do not let truck bump machine

m. Keep operation as smooth as possible

n. Do not stop suddenly

o. Do not stop machine for long periods of time

p. Operate controls smoothly

14. Answer should include any ten of the following

a. Perform all prestart inspection and maintenance procedures

b. Learn the location and function of all controls

c. Be sure all screed adjustments are made before operation begins

d. Make precise adjustments after operation is underway

e. Make additional adjustments as needed during operation

f. Make small, gradual adjustments

g. Watch mat for uneven surface

h. Control mat thickness with periodic depth checks

i. Learn how to identify surface faults and how to correct them

j. Watch head of material to make sure that it is feeding correctly

k. Keep angle of attack as consistent as possible

l. Signal laydown operator when you see mat problems that cannot be corrected by adjusting screed

ANSWERS TO TEST

- m. Help shovel or rake as needed
- n. Be prepared to relieve laydown operator when needed

15. b, d, e, g, h, k, l, n, p, q

16. Performance skills evaluated to the satisfaction of the instructor

ASPHALT RECYCLING MACHINES
UNIT XI

UNIT OBJECTIVE

After completing this unit, the student should be able to operate a heavy-duty and/or medium-duty asphalt recycling machine safely and effectively. This knowledge will be shown by completing job sheets and unit test with a minimum score of 85 percent.

SPECIFIC OBJECTIVES

After completing this unit, the student should be able to

1. Match terms associated with asphalt recycling machines to their correct definitions.
2. Arrange in order stages in the asphalt recycling process.
3. Match factors that affect production to their correct functions.
4. Identify the parts of a heavy-duty asphalt recycling machine.
5. Match controls on a heavy-duty asphalt recycling machine to their correct functions.
6. Identify the parts of a medium-duty asphalt recycling machine.
7. Match controls on a medium-duty asphalt recycling machine to their correct functions.
8. State safety rules for operating an asphalt recycling machine.
9. State procedures for safe burner operation.
10. Select from a list causes of overheating.
11. Select from a list procedures for effective asphalt recycling machine operation.
12. Select from a list operating procedures for a heavy-duty asphalt recycling machine.
13. Select from a list operating procedures for a medium-duty asphalt recycling machine.
14. Select from a list procedures for torch operation.
15. Demonstrate the ability to
    a. Perform prestart inspection and maintenance procedures on an asphalt recycling machine.
    b. Service an asphalt recycling machine.
    c. Start, warm up, operate, clean, and shut down a heavy-duty asphalt recycling machine.

OBJECTIVE SHEET

d. Start, warm up, operate, clean, and shut down a medium-duty asphalt recycling machine.

e. Repair potholes.

ASPHALT RECYCLING MACHINES
UNIT XI

SUGGESTED ACTIVITIES

I. Suggested activities

  A. Order materials to supplement unit.

    1. Operator's manuals for the equipment students will use.

    2. Video-tape cassette--*Porta-Patcher.* Two cassettes, color, 102 minutes, Beta-1, 1/2" video-tape, Kansas Department of Transportation. Available from Training Division, Kansas Department of Transportation, State Office Building, Topeka, Kansas 66612, (913) 296-3721.

    (NOTE: This video-tape cassette provides a complete explanation of the operation and maintenance of the Brown Porta-Patcher. The first part covers safety and operation, and runs sixty-two minutes. The second part covers maintenance, and runs forty minutes.)

  B. Provide students with objective sheet.

  C. Provide students with information and job sheets.

  D. Discuss unit and specific objectives.

  (NOTE: "Medium-weight asphalt recycling machine" refers to a BOMAG AR-5 or AR-6 "heavy-duty asphalt recycling machine" refers to the Brown Porta-Patcher.)

  E. Discuss information sheet.

  (NOTE: You may want to limit study and discussion to the equipment available.)

  F. Demonstrate and discuss procedures outlined in job sheets.

  G. Provide alternate jobs if those in job sheets are not practical.

  H. Arrange a field trip for students to observe recycling operations such as pothole repair.

  I. Review treatment of burns in departmental safety manual.

  J. Stress the need to follow operating instructions *exactly* as it is important that the sequence for each specific type of machine is correct.

  (NOTE: If students are learning to operate both types of recyclers, it is very important that they do not confuse the procedural sequence. To do so can cause fires and injury.)

  K. Demonstrate characteristics of properly heated asphalt material.

SUGGESTED ACTIVITIES

L. Allow unit to catch fire, and then demonstrate the proper techniques for controlling a fire.

(NOTE: See Porta-Patcher operating instructions for emergency and non-emergency procedures.)

M. Give test.

II. Instructional materials

A. Objective sheet

B. Suggested activities

C. Information sheet

D. Job sheets

1. Job Sheet #1--Perform Prestart Inspection and Maintenance Procedures on an Asphalt Recycling Machine

2. Job Sheet #2--Service an Asphalt Recycling Machine

3. Job Sheet #3--Start, Warm up, Operate, Clean, and Shut Down a Heavy-Duty Asphalt Recycling Machine

4. Job Sheet #4--Start, Warm Up, Operate, Clean, and Shut Down a Medium-Duty Asphalt Recycling Machine

5. Job Sheet #5--Repair potholes

E. Test

F. Answers to test

III. Unit references

A. *BOMAG AR-6 Asphalt Recycler Operation, Maintenance, and Parts Manual.* Port Washington, Wisconsin: Koehring Construction Equipment, 1981.

B. *BOMAG AR-5 Asphalt Recycler Instruction Manual.* Port Washington, Wisconsin: Koehring Construction Equipment, 1980.

C. *Porta-Patcher.* Topeka, Kansas: Kansas Department of Transportation, n.d.

D. *Porta-Patcher Asphalt Recycler Operating Instructions.* Fort Wayne, Indiana: Brown Equipment Co., Inc., n.d.

ASPHALT RECYCLING MACHINES
UNIT XI

INFORMATION SHEET

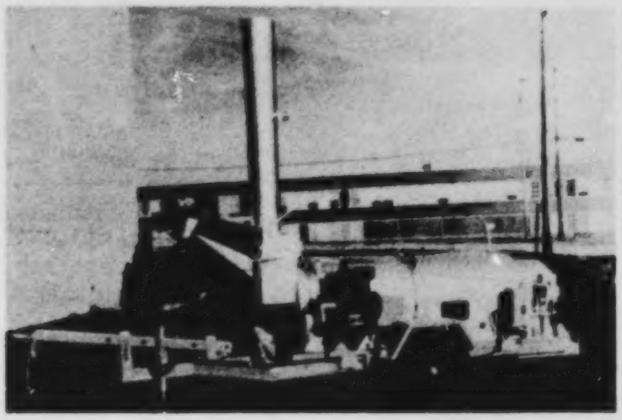
I. Terms and definitions

A. Asphalt recycling machine--Towed machine that heats and breaks up salvaged asphalt material or reheats prepared mix and returns it to a usable state for asphalt repair work (Figures 1 and 2)

(NOTE: The recycler may also be used for drying materials.)

EXAMPLE: Heavy-duty asphalt recycling machine

FIGURE 1

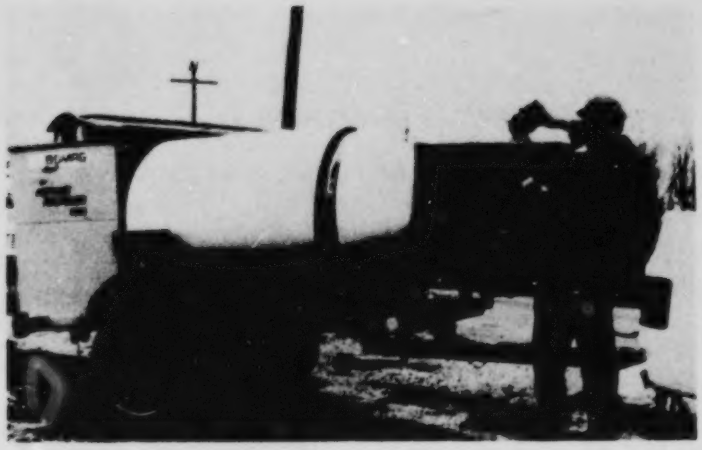


Courtesy of Brown Equipment Company, Inc., Fort Wayne, Indiana.

INFORMATION SHEET

EXAMPLE: Medium-duty asphalt recycling machine

FIGURE 2



Courtesy of Bomag Division, Koehring Construction Equipment Company.

B. Salvage--To keep or save materials that might be discarded or destroyed

C. Recycle--To make usable materials that might be discarded or destroyed

D. Torch--Accessory used for thawing frozen dirt and melting ice, for cleaning and heating tools, and for drying potholes and holes on bridge decks

E. Coke--Material left when asphalt burns and dries; to burn material onto a surface

F. Fines--Small particles of material

G. Slope--Degree or angle of tilt; measured from tongue-jack to burner on recycling machine

(NOTE: To "increase slope" means to jack up tongue end of recycler.)

H. psi--Pressure measured in pounds per square inch

II. Stages in the asphalt recycling process (Job Sheet #5)

(NOTE: Two models are presented in this unit: a heavy-duty recycling machine and a medium-duty machine. The process is basically the same, but the operating procedures are *not* the same. Be sure you know the machine you are learning to operate and do not confuse the two.)

A. Chunks of salvaged asphalt material are shoveled into a hopper from a dump truck bed

INFORMATION SHEET

B. Material goes into a rotating drum

C. Liquid propane gas (LPG) burners heat air inside drum to high temperatures (400°F to 750°F)

(NOTE: Temperature varies with type of material. Thermostats and gauges regulate *air temperature*, not material temperature.)

D. Asphalt material falls through hot air, heats to between 250°F and 350°F, and returns to a usable state

(NOTE: Sometimes additional asphalt material, aggregate, or a chemical rejuvenating agent is added to produce the right mix.)

E. Drum is tilted (sloped) so that material moves through the hot air and toward discharge door for a certain amount of time

(NOTE: The length of slope time varies with the type of material.)

F. Material drops through discharge door onto receiving tray and is ready to use

III. Functions of factors that affect production

(NOTE: It is the operator's job to get the best quality patch material possible. The operator searches for the right adjustments so that the material is heated to optimum temperature--as hot as possible without causing material to smoke or burn.)

A. Gas pressure--Controls temperature ranges and burning quality of flame

B. Slope--Moves material through unit and determines the length of time material is exposed to heat

(NOTE: Slope determines production rate. If there is too much angle, the material will move too quickly and will not heat properly. If there is too little angle, material will overheat.)

C. Rate of rotation--Mixes material and keeps it circulating through heat

(NOTE: If material does not move, it does not heat. If rotation is too slow, material will collect on bottom of drum and will overheat. If rotation is too fast, material will be held against the sides of the drum and will overheat.)

D. Temperature--Heats material to optimum temperature so that it will make good patching material

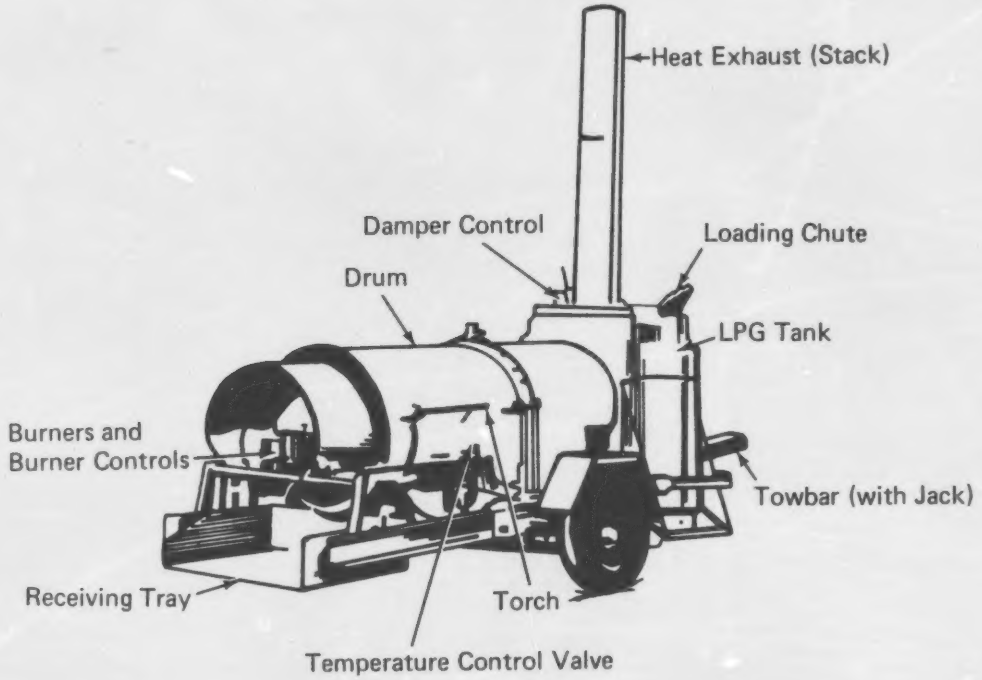
(NOTE: Optimum temperature will vary with material used. Each batch will be different.)

INFORMATION SHEET

IV. Parts of a heavy-duty asphalt recycling machine (Figure 3; Job Sheets #1-#3)

(NOTE: Discharge door is located on drum at burner end and is always open.)

FIGURE 3


Heat Exhaust (Stack)
Damper Control
Loading Chute
Drum
LPG Tank
Burners and Burner Controls
Towbar (with Jack)
Receiving Tray
Torch
Temperature Control Valve

Adapted with permission of Brown Equipment Co., Inc., Box 9799, Fort Wayne, Indiana 46899.

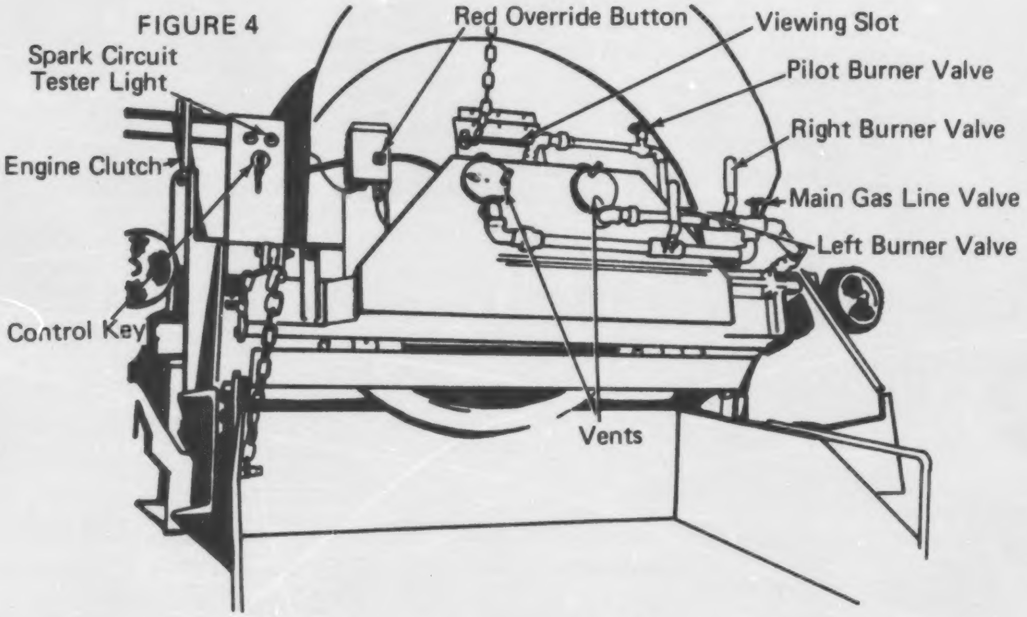
INFORMATION SHEET

V. Controls on a heavy-duty asphalt recycling machine and their correct functions (Job Sheet #3)

A. Rear end controls (Figure 4)

EXAMPLE:

FIGURE 4


Red Override Button
Viewing Slot
Spark Circuit Tester Light
Pilot Burner Valve
Right Burner Valve
Engine Clutch
Main Gas Line Valve
Left Burner Valve
Control Key
Vents

Adapted with permission of Brown Equipment Co., Inc., Box 9799, Fort Wayne, Indiana 46899.

1. Control key--Activates electrical spark ignition system
2. Spark circuit tester light--Indicates that igniter plug is creating sparks to ignite pilot burner
3. Red override button--Permits pilot to burn until thermocouple is heated to operating temperature and burner will light
4. Main gas line valve--Controls gas flow from tank to main burners and pilot burner
5. Pilot burner valve--Controls gas flow to pilot burner
6. Left burner valve--Controls gas flow to left burner

   (NOTE: Left burner should burn at a low, controlled rate with a 12-inch to 14-inch flame. This procedure balances the heat flow and permits more control.)

7. Right burner valve--Controls gas flow to right burner

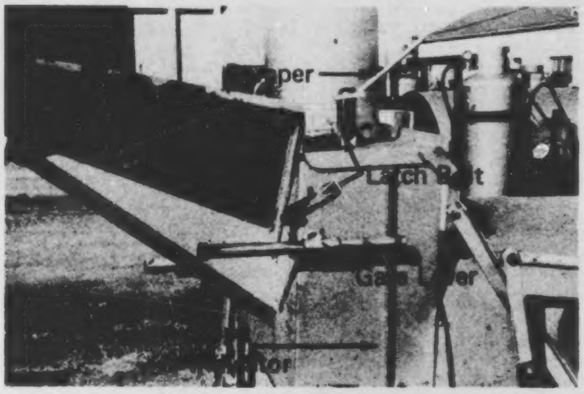
   (NOTE: Right burner should be used to adjust flame and temperature.)

8. Engine clutch--Starts or stops drum rotation
9. Vents--Admit more oxygen to burner

B. Stack controls (Figure 5)

EXAMPLE:

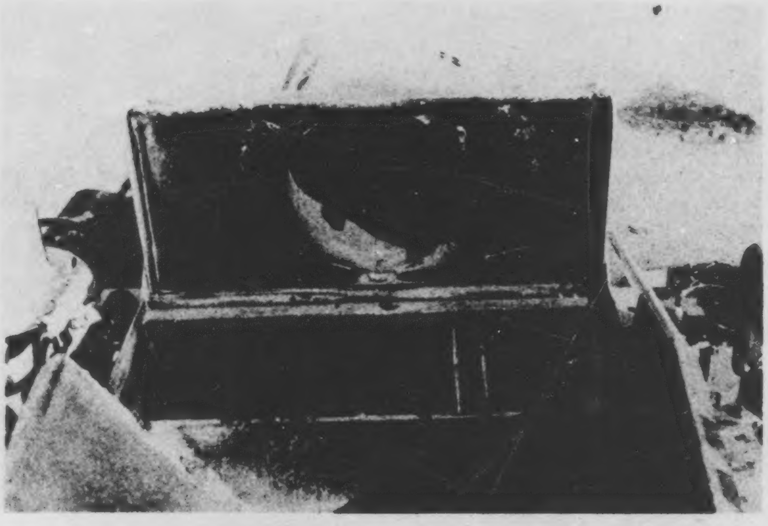
FIGURE 5


Damper
Latch Bolt
Gate Lever

1. Damper--Controls air flow to flame in drum (Figure 6)

EXAMPLE:

FIGURE 6



INFORMATION SHEET

2. Stack latch bolt–Secures smokestack in upright position

3. Gate lever--Opens gate to admit material; closes gate to keep hot gases inside

   (NOTE: Gate operates automatically.)

   (CAUTION: Do not open gate and look inside. Open gate lets in too much oxygen, and hot gases can blow into your face.)

C. Other controls

1. Slope indicator–Shows degree of slope (Figure 5)

   (NOTE: When preheating, slope should be in negative range to the left of zero. For most operations, slope should be between zero and one.)

2. Supply tank gas valve–Controls gas flow from LPG tank to main gas lines

   (NOTE: The supply tank gas valve is a pressure regulator valve mounted on the fuel tank.)

3. Engine controls–Start or stop engine; adjust drum rotation rate

   (NOTE: Controls include electric start, throttle, choke, fuel shut-off, and stop switch.)

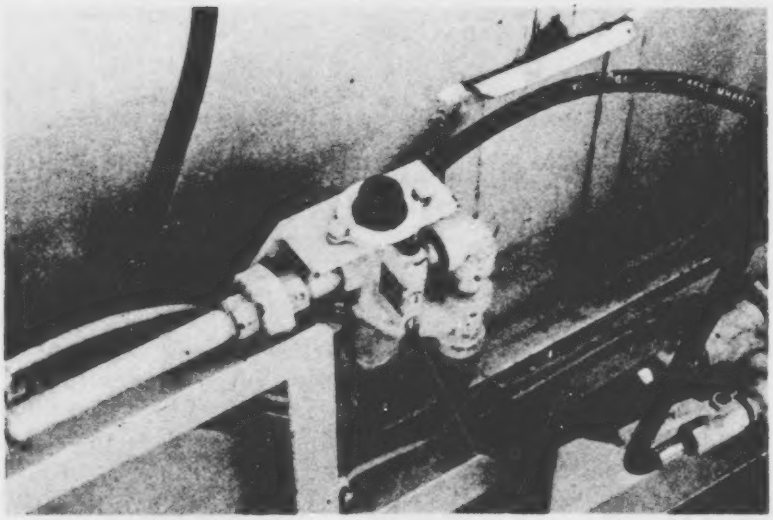
INFORMATION SHEET

4. Temperature control (black knob)--Selects desired temperature for mixing air in drum (Figure 7)

   (NOTE: The selector sets *air temperature* inside the drum, *not* material temperature. Each black mark is 10°F. The thermostat is in the smokestack, and any change in temperature at the control setting takes time to come into effect. Be sure to lower heat at the *first sign* of smoke.)

   EXAMPLE:

FIGURE 7



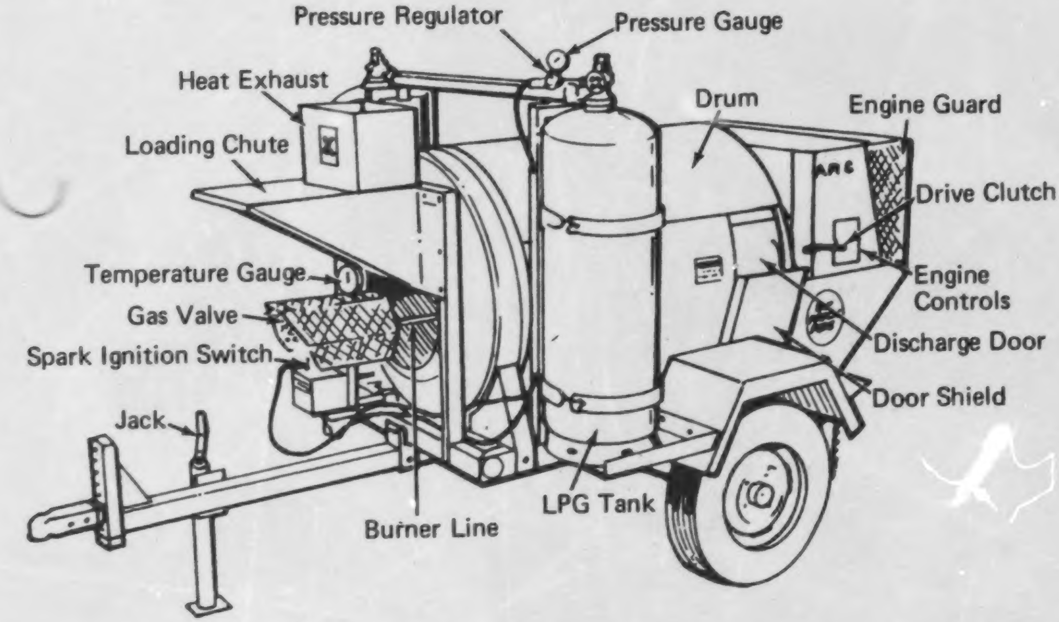
5. Jack--Adjusts slope

INFORMATION SHEET

VI. Parts of a medium-duty asphalt recycling machine (Figure 8; Job Sheets #1, #2, and #4)

(NOTE: Controls will vary with manufacturer and model. Discharge tray is not shown. It hangs under the unit at the rear. Temperature gauge registers *air temperature* in the drum, *not* material temperature.)

FIGURE 8


Pressure Regulator
Pressure Gauge
Heat Exhaust
Drum
Engine Guard
Loading Chute
Drive Clutch
Temperature Gauge
Engine Controls
Gas Valve
Discharge Door
Spark Ignition Switch
Door Shield
Jack
LPG Tank
Burner Line

Used with permission of the Koehring Construction Equipment Company.

VII. Controls on a medium-duty asphalt recycling machine and their correct functions (Job Sheet #4)

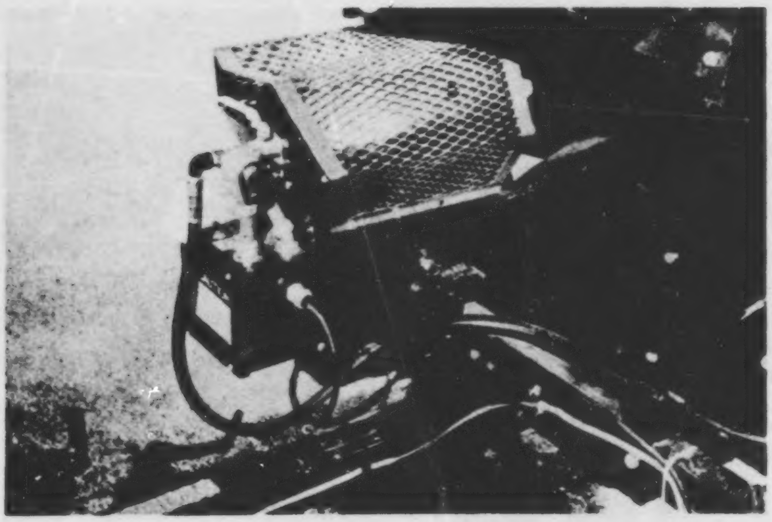
A. Spark ignition switch–Provides electric spark to ignite gas burner (Figure 9)

INFORMATION SHEET

B. Gas valve--Adjusts gas flow to burner (Figure 9)

EXAMPLE: Spark ignition switch and gas valve

FIGURE 9



C. Temperature gauge–Registers mixing air temperature in drum

D. Pressure regulator–Controls LPG pressure at tank

E. Pressure gauge--Registers LPG pressure at tank

F. Drive clutch–Starts or stops drum rotation

G. Engine controls--Start or stop engine

(NOTE: Engine controls include fuel flow valve, choke, rope-pull starter, and stop button.)

H. Throttle--Controls engine speed and drum rotation speed

(NOTE: On some models the throttle is located on the outside, over the clutch.)

I. Jack--Adjusts slope

VIII. Safety rules for operating an asphalt recycling machine

(NOTE: The most important factor in operating equipment safely is to know your machine. Know its limitations and stay within those limitations.)

A. Read operator's manual thoroughly: know your machine

INFORMATION SHEET

B. Study departmental safety manual

C. Wear clothing that can be easily removed and that fits closely enough not to get caught in moving parts

D. Carry first-aid kit

E. Place fire extinguisher where it can be easily reached

(NOTE: There is little danger of the unit itself catching fire, but the operator's clothing can catch fire. Keep fire extinguisher handy.)

F. Know the material you are using and the temperature range for that material

G. Keep hands away from rotating drum

H. Do not touch hot metal

I. Be sure all guards and shields are in place and in good operating condition

J. Stop engine before adding fuel or oil

K. Do not leave unit running unattended

L. Watch machine carefully for signs of overheating

EXAMPLES: Blue or gray smoke, deep red flame

M. Do not allow material to overheat

(NOTE: Overheating will turn material on drum walls to coke, and it will have to be chipped out. A *light* coking on the drum insulates it and keeps the heat in. A heavy coking keeps heat out.)

N. Clean recycler after each use

IX. Procedures for safe burner operation

A. Before lighting pilots or burners, check and recheck to make sure that all valves are closed

B. Use soapy water to check for leaks

(CAUTION: Do not use open flame or match.)

C. Before lighting pilots or burners, be sure that engine and drum are operating properly

INFORMATION SHEET

D. Rotate drum before lighting heaters

(CAUTION: Do not operate heaters without rotating drum.)

E. Stand to one side when lighting burners

(NOTE: Never light burner with your head or body in front of the burner. Severe burns could result.)

F. If burners do not light instantly, shut down unit and clean burner valves

(CAUTION: Wait at least ten minutes before relighting.)

G. Bleed all gas lines and valves when shutting down unit

X. Causes of overheating

(NOTE: "Smokin' is cokin'." When unit gives off smoke, correcting any of the following causes will help reduce the temperature.)

A. Drum turning too fast

B. Drum turning too slowly

C. Temperature too high

D. Too much material

E. Too little slope

XI. Procedures for effective asphalt recycling machine operation

A. Perform all prestart inspection and maintenance procedures

B. Know requirements for the machine you are using

C. Adjust towbar so that unit clears open tailgate

D. Place equipment as close to repair job as possible

E. Adjust temperature as needed to keep material properly heated

F. Keep slope constant once it is properly adjusted

(NOTE: In case of overheating, slope will have to be increased to move material out of drum.)

G. Feed material into hopper at uniform rate

(NOTE: Do not produce more material than can be used before it cools.)

INFORMATION SHEET

H. Keep drum fairly full

I. Keep drum rotation constant at proper speed

J. Shovel out material from one place on tray

(NOTE: As material gets cold, shovel it to one side and later reheat it in the unit.)

K. Turn shovel over to place material

(NOTE: Do not throw material, or coarse material will go to corners where fine material is needed, and the patch will not hold as well.)

L. Be sure flames burn blue with yellow ends

(NOTE: If pilot burner burns yellow, carbon will build up and may clog the valve so that the flame will not heat the thermocouple.)

M. Rather than running burners wide open, use a moderate flame over a longer period of time

N. Clean material off receiving tray occasionally

(NOTE: Do not let material harden on the tray.)

O. Test recycled material for correct application temperature

(NOTE: To check for correct temperature, turn over a shovelful of material. If it smokes a little and quits, it is ready. If it keeps smoking, it is overheated and the asphalt is becoming degraded.)

P. Clean all unused material from road

XII. Operating procedures for a heavy-duty asphalt recycling machine

A. Rotate drum before lighting burners

B. Preheat drum before adding material

(NOTE: Preheat temperature may be 650°F to 750°F.)

C. Reduce temperature when material is first added

D. Use trial and error method to find best temperature and slope for material used

(NOTE: Heat material until it smokes. Then reduce temperature and increase slope until you find the correct setting. There will be no blue or gray smoke at the stack or the loading chute. When material is turned out of unit, it will be a shiny black color and will smoke briefly and then stop.)

INFORMATION SHEET

E. Adjust damper as needed for heating and maintaining temperature

(NOTE: If you hear a poofing noise, burners are getting too little air; open damper.)

F. Operate with damper closed as much as possible

G. Keep LPG pressure at 22 to 24 pounds per square inch (psi)

(NOTE: Greatest efficiency and highest heating value occurs when pressure is 20 psi at the burner and 22 to 24 psi at the regulator. *Do not raise LPG pressure.* Excess gas will not vaporize and will cool the burners so that they produce less heat.)

H. Run left burner at a minimum flame (12 to 14 inches high); run right burner open

(NOTE: This procedure gives more even heating and gives the operator more control.)

I. Adjust temperature ten degrees at a time (one mark on dial) until material is at correct application temperature

J. Add material slowly at first, then increase load

(NOTE: Start with ten to fifteen shovelfuls.)

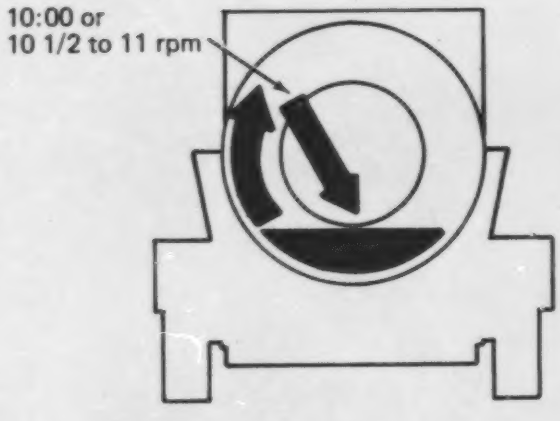
K. Replace jack handle after use

(NOTE: If handle is left in operating position, it creates a hazard.)

L. Set drum rotation so that material falls from a ten o'clock position (Figure 10)

EXAMPLE:

FIGURE 10



Adapted with permission of the Koehring Construction Equipment Company.

INFORMATION SHEET

XIII. Operating procedures for a medium-duty asphalt recycling machine

A. Do not run burner without rotating drum

B. Do not let heated drum remain empty for more than thirty seconds

C. Adjust temperature with gas valve and/or fuel pressure valve

(NOTE: For hotter material, open gas valve wide open and raise fuel pressure to 40 psi.)

(CAUTION: Do not let pressure exceed 40 psi.)

D. Do not let temperature exceed 600°F

(NOTE: Operating the unit at a temperature above 600°F could damage the drum and other parts, and overheat or burn the material.)

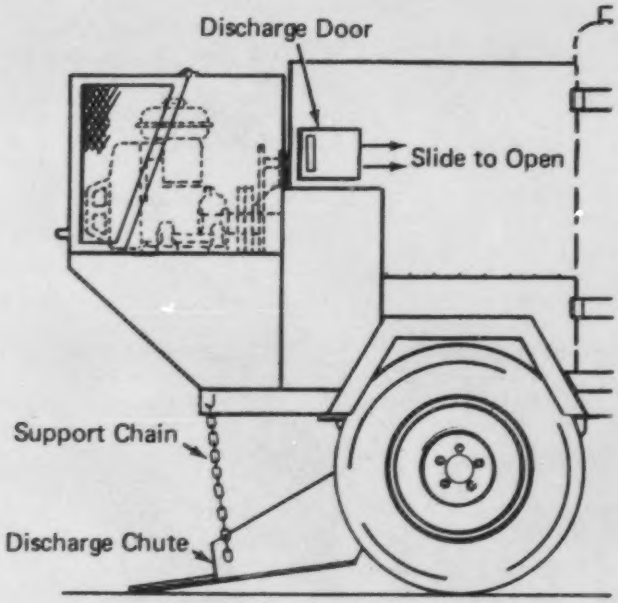
E. Open and close discharge door by hand

F. Stop drum rotation to open or close discharge door

G. Adjust discharge chute as needed for delivery and travel (Figure 11)

EXAMPLE: Discharge chute in delivery position

FIGURE 11



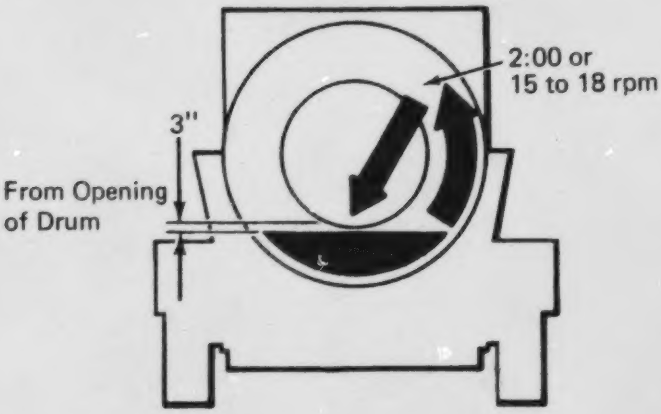
Used with permission of the Koehring Construction Equipment Company.

INFORMATION SHEET

H. Set drum rotation so that material falls from a two o'clock position (Figure 12)

EXAMPLE: Material falling from two o'clock position

FIGURE 12



Used with permission of the Koehring Construction Equipment Company.

I. Jack up burner end 4 to 8 inches

J. Use manufacturer's temperature chart for type of material being used

EXAMPLE:

TEMPERATURE VARIABLES	CHUNKS HOT MIX	CHUNKS COLD MIX
Temperature gauge at maximum reading	600°F	400°F
Time at temperature 400 pound load	9 min.	5 min.
Material temperature	250°F	250°F

XIV. Procedures for torch operation

(NOTE: The torch has a pilot flame that will ignite the burner when the on/off squeeze valve is activated. Flow valve on handle sets flame size. When squeeze valve is pressed, flame will always be the same size.)

A. Expose pilot to flame for only an instant

(NOTE: Do not leave torch in burner; it will damage the wiring.)

INFORMATION SHEET

B. Bleed lines after shutdown

C. Be sure torch is completely out before putting it on machine

D. Be sure torch is secure before moving unit

ASPHALT RECYCLING MACHINES
UNIT XI

JOB SHEET #1--PERFORM PRESTART INSPECTION AND MAINTENANCE PROCEDURES ON AN ASPHALT RECYCLING MACHINE

I. Equipment and materials

   A. Asphalt recycling machine

   B. Operator's manual

   C. Engine oil

   D. Diesel

   E. Fuel

   F. Lubricants

   G. Grease gun

   H. Rags

   I. Soapy water and brush

II. Procedure

(NOTE: Deficiencies should be corrected immediately or reported to the proper authority. Do not operate defective equipment.)

   A. Make a walk-around visual inspection for leaks and broken, worn, or missing parts

   B. Check engine oil level; add or change engine oil if needed

   (NOTE: Be sure unit is level.)

   C. Check fuel level; fill tank if necessary

   D. Check battery connections for tightness and corrosion

   E. Check battery electrolyte level; add water if needed

   F. Check air cleaner; remove and clean filter if necessary

   G. Check tires

   H. Clean all grease fittings and lubricate according to operator's manual

   (NOTE: Lubricate jack bearings and main roller bearings daily, more often in dirty conditions.)

JOB SHEET #1

I. Check drive belts for tightness; adjust if necessary

J. Check electrical wire connections and insulation

K. Use soapy water to check gas lines and fittings for leaks

(CAUTION: Do not use match or open flame.)

L. Check levers and controls for proper functioning

M. Check lights

N. Check safety devices

O. Apply a light coat of diesel to feeding chute and receiving tray

ASPHALT RECYCLING MACHINES
UNIT XI

JOB SHEET #2--SERVICE AN ASPHALT RECYCLING MACHINE

I. Equipment and materials

- A. Asphalt recycling machine
- B. Operator's manual
- C. Tool kit
- D. Grease gun
- E. Lubricants
- F. Cleaning solvents
- G. Rags
- H. Water
- I. Engine oil
- J. Tire pressure gauge
- K. Fuel

II. Procedure

(NOTE: Follow departmental preventive maintenance program when servicing equipment. Refer to operator's manual for lubrication chart and for servicing specific components and attachments.)

A. Visually inspect for leaks and broken, worn, or missing parts

(NOTE: Major repairs and replacements should be reported to the proper authority and completed by a trained mechanic.)

B. Check engine oil level, filter, lines, and hoses; add or change engine oil if needed

C. Clean air filter; replace if necessary

D. Check fuel level, fuel filters, and sediment bowl (where applicable); fill fuel tank if necessary

E. Check battery electrolyte level, battery cables, and connectors; add water if needed

(CAUTION: Keep sparks and fire away from battery.)

F. Check exhaust system for loose connections and holes

JOB SHEET #2

G. Check clutch adjustment; adjust if necessary

H. Check drive belts for tension and wear; adjust or replace if necessary

I. Check wiring, insulation, and connections

J. Clean and lubricate all grease fittings according to operator's manual

K. Check condition of tires

L. Check tire pressure; inflate to recommended pressure

M. Check all safety devices; repair if necessary

N. Check burner electrode assembly; adjust if necessary

(NOTE: Assembly should be located so that tips are inside flame envelope and about 1/2 inch above base of flame.)

O. Check burners for carbon build up; clean if necessary

(NOTE: On heavy-duty model, remove control key when cleaning burners.)

P. Check drum for coke build up; clean if necessary

(NOTE: Keep drum clean; removing coke is hard work.)

ASPHALT RECYCLING MACHINES
UNIT XI

JOB SHEET #3--START, WARM UP, OPERATE, CLEAN, AND SHUT DOWN A HEAVY-DUTY ASPHALT RECYCLING MACHINE

I. Equipment, materials, and personnel

  A. Asphalt recycling machine (Porta-patcher)

  B. Operator's manual

  C. Dump truck

  D. Chunks of salvaged hot asphalt pavement

  E. Two shovels

  F. Shoveler

  G. Spray equipment

  H. Diesel

  I. Recommended safety equipment

    1. Goggles

    2. Hard hat

    3. Close-fitting clothing

    4. Respirator

    5. Gloves

    6. Insulated shoes

    7. Fire extinguisher

II. Procedure

  A. Read operator's manual thoroughly; know your machine

  B. Perform all prestart inspection and maintenance procedures

  C. Start engine and let it warm up at a low idle

  D. Raise stack

    1. Open stack latch at base

    2. Release pulldown chain

JOB SHEET #3

3. Push stack upright
4. Close stack latch
5. Insert safety pin

E. Open damper halfway and lock it in place

F. Set slope on the negative

(NOTE: Lower tongue end until slope indicator needle is to the left of zero.)

G. Make sure that all gas line valves and all burner shut-off valves are closed

H. Give feed chute and receiving tray a *light* coating of diesel

I. Set temperature control at 300°F

J. Increase engine speed to just below point of highest engine vibration

K. Engage engine clutch and start drum rotation

L. Open supply tank valve *slowly* and let pressure *slowly build* to between 22 and 24 psi

M. Recheck pilot burner valve and main burner valves; make sure that they are closed

N. Turn control key clockwise to RUN position

(NOTE: Spark circuit tester light should flash, and spark should be visible at igniter plug on pilot burner.)

O. If igniter plug is sparking properly, open pilot burner valve fully

P. Turn control key to START position, and at the same time push in and hold the red override button until the red light stays on when button is released and key is returned to RUN position

(CAUTION: If pilot burner does not light immediately, close pilot burner valve and wait ten minutes before relighting.)

(NOTE: Pull ignition wire from spark plug and clean pilot burner if pilot does not light.)

Q. Set temperature control at 650°F to 750°F

(NOTE: This is the *preheat* temperature, not the operating temperature. See operator's manual if you are using cold-mix or recycled cold-mix blend.)

JOB SHEET #3

R. Open main gas line valve

S. Turn on individual burner valves one at a time

(NOTE: Each burner should light immediately. Clean the nozzle of any burner that does not light instantly.)

T. Check gas pressure to be sure that it is 22 psi with both burners on; adjust if needed

U. Let unit preheat for seven to ten minutes

(NOTE: Place bare hand *near*, not on, exhaust box at front of drum. When radiated heat is *very hot*, unit is preheated.)

V. Jack up front until slope indicator points one-half to three-fourths the distance between zero and one

(NOTE: Slope will be different for different materials.)

W. Adjust left burner so that flame is mostly blue with a yellow tip and is about 12 to 14 inches high

X. Open right burner three-fourths to fully open

Y. Signal shoveler to start loading hopper

(NOTE: Load only ten to fifteen shovelfuls at this time or 1 1/2 cubic feet per minute [cfm]. This amount will change with different materials.)

Z. If burners repeatedly go out and then relight with a poofing sound, raise damper handle a few degrees

(NOTE: A poofing sound means that more air is needed to burn fuel.)

AA. Look through slot in little door in rear shield to check drum rotation

(NOTE: Material should be falling off drum at ten o'clock position and should be completely off the drum by one o'clock position. If material falls *before* the ten o'clock position, drum is turning too slowly. If material is still on the drum at the one o'clock position, drum is turning too fast.)

BB. Adjust engine speed for proper drum rotation

CC. Watch for signs of overheating

EXAMPLES: Blue or light gray smoke from stack and around the front chute, red flame filling drum

(NOTE: Material should be heated until it begins to smoke.)

JOB SHEET #3

DD. *Immediately* lower temperature

1. Increase slope: jack up front of inner frame to increase rate of discharge from drum

2. Reduce temperature control setting to about 600°F

3. Reduce left burner flame until it is 10 to 12 inches high

4. Cut right burner flame back a little at a time until proper temperature is reached

5. Add material at a faster rate

(CAUTION: If material is burning with a deep red flame and does not go out, follow these procedures: 1] Turn off control key [this will shut off gas valves and spark igniter] ; 2] stop drum rotation; 3] close damper.)

EE. Test discharge material for correct temperature

1. Turn out a shovelful of material

2. Watch blue smoke; if asphalt continues smoking, it is too hot; if asphalt smokes for a minute and then stops, it is ready

FF. Adjust temperature as needed, ten degrees (one black mark) at a time

GG. Adjust slope as needed

(NOTE: At optimum slope and material temperature, there is no smoke.)

HH. To stop production for a short time, turn off main gas line valve (leaving burner valves in position) and stop drum

(NOTE: To restart, open main gas line valve fully, and *immediately* engage clutch to start drum rotation.)

II. Clean unit

1. Reduce temperature control setting to between 375°F and 400°F

2. Set damper to half-closed position

3. Let all material empty out of machine

(NOTE: When only fines comes out, drum is nearly empty. Failure to reduce the temperature when cleaning the unit will coke the drum.)

JOB SHEET #3

JJ. Shut down unit

1. Close supply tank valves
2. Quickly turn off pilot burner valve when gas pressure drops below 20 psi

   (NOTE: This will prevent the formation of carbon in the pilot burner.)
3. Continue burning right-hand main burner until gas lines are emptied
4. Turn off control box key and remove it from switch
5. Turn off all gas supply valves
6. Stop drum rotation
7. Shut off engine
8. Let drum and burners cool

   (NOTE: When transporting recycler, drum can be left rotating while moving.)
9. Spray a *light* coating of diesel on feed chute, receiving tray, and rearmost mixing fins in drum

   (NOTE: Do not use too much diesel or it will smoke when unit is relighted.)

ASPHALT RECYCLING MACHINES
UNIT XI

JOB SHEET #4--START, WARM UP, OPERATE, CLEAN, AND SHUT DOWN A MEDIUM-DUTY ASPHALT RECYCLING MACHINE

I. Equipment, materials, and personnel

- A. Asphalt recycling machine (BOMAG)
- B. Operator's manual
- C. Dump truck
- D. Chunks of salvaged asphalt pavement
- E. Shovels
- F. Shoveler
- G. Recommended safety equipment
  - 1. Goggles
  - 2. Hard hat
  - 3. Close-fitting clothing
  - 4. Respirator
  - 5. Gloves
  - 6. Insulated shoes
  - 7. Fire extinguisher

II. Procedure

- A. Read operator's manual thoroughly: know your machine
- B. Perform all prestart inspection and maintenance procedures
- C. Make sure that all valves are in OFF position and that sliding discharge door is closed
- D. Start engine and let it warm up
  - 1. Be sure that clutch is disengaged
  - 2. Turn gas line valve to ON
  - 3. Turn ON/OFF switch to ON
  - 4. Open choke

JOB SHEET #4

5. Set throttle at low idle: one-quarter to one-third open

6. Pull starting rope until engine starts, or press start button, if machine is so equipped

   (NOTE: Release button when engine starts.)

7. Close choke after engine starts

E. Lower discharge chute

F. Open fuel tank valves *slowly* and let pressure build to between 25 and 30 psi

G. Add 300 to 375 pounds of material through chute above main burner

   (NOTE: Use chute above engine for crushed or milled material.)

H. After warm-up period, engage clutch and start drum rotation

I. Light pilot burner according to operator's manual

   (CAUTION: Do not operate heater without rotating drum.)

J. Adjust throttle so that drum rotation is at correct speed for material used

   (NOTE: Material should fall off the sides at two o'clock and land at seven o'clock position. If material falls off before it should, drum is turning too slowly. If material is still on drum after seven o'clock position, drum is turning too fast.)

K. Open main burner valve fully

L. Be sure flame burns steadily

M. Check operator's manual for correct temperature for material used

   (NOTE: Temperature gauge registers air temperature, *not* material temperature. For example, if the gauge reads 600°F, the material is about 250°F. If more heat is needed, increase fuel pressure.)

N. When temperature gauge reaches fifty degrees below the desired temperature, adjust main valve so that desired temperature is maintained

   (CAUTION: Do not let material overheat. At the first sign of blue or dark gray smoke, turn burner down.)

O. Jack up towing tongue so that burner end is 4 to 8 inches higher than engine end and material moves toward discharge door

JOB SHEET #4

P. Run burner six to eight minutes until material is ready for application

(NOTE: Material will make a scratching sound in the drum when it is properly dissolved.)

(CAUTION: Do not allow material to overheat.)

Q. Disengage clutch so that drum stops with discharge door facing you

(CAUTION: Do not attempt to open discharge door while drum is rotating.)

R. Slide door open

S. Engage clutch to rotate drum

T. At the first sign of blue or dark gray smoke, turn burner down

U. Shovel out material from discharge chute, and place by turning shovel over; do not throw material

V. Empty all material from drum

W. Turn off main gas valve and pilot needle valve

X. Turn off valves on top of each tank

(NOTE: Do not leave main gas valve and/or pilot needle valve open when recycler is not in operation. Gas can build up inside drum and will flash on the next start-up.)

Y. Allow drum to cool

Z. Stop drum so that discharge door faces you

AA. Close discharge door

BB. Add diesel to clean inside of drum

CC. Rotate drum until asphalt is dissolved from sides

DD. Stop drum rotation so that discharge door faces you

EE. Open discharge door

FF. Start drum rotation

GG. Allow all diesel to run out and clean discharge chute

HH. Stop drum rotation

II. Shut down engine

JJ. Raise discharge chute to travel position and secure it

ASPHALT RECYCLING MACHINES
UNIT XI

JOB SHEET #5–REPAIR POTHOLES

I. Equipment, materials, and personnel

  A. Asphalt recycling machine

  B. Operator's manual

  C. Salvaged hot or cold mix asphalt pavement

  D. Shovels

  E. Picks

  F. Broom

  G. Asphalt distributor, or oil heater and applicator unit

  H. Dump truck

  I. Vibrator-compactor or small roller, if available

  J. Diesel

  K. Spray equipment

  L. Two-person crew

  M. Traffic control devices

  N. Recommended safety equipment

    1. Hard hat

    2. Visible vest

    3. Goggles

    4. Insulated shoes

    5. Gloves

    6. Respirator

    7. Fire extinguisher

II. Procedure

  A. Perform prestart inspection and maintenance procedures

  B. Move to job site

  C. Park unit as close to repair as possible

JOB SHEET #5

D. Place traffic control devices

E. Use jack to adjust recycling machine to ground slope

(NOTE: Before starting, set on negative slope.)

F. Warm up recycling machine engine

G. Clean pothole with shovel, pick, and broom; straighten edges

H. Preheat recycler, if needed

I. Spray or spread heated liquid asphalt material in pothole

(NOTE: Be sure all surfaces are covered with liquid asphalt material.)

J. Check pothole preparation, heating system, rotation, and gas pressure; when ready, signal shoveler to load material according to operating instructions

K. Check rotation speed

L. Test material for proper temperature and adjust machine as needed; keep testing until material is ready to apply

M. Shovel material from one section of tray

(NOTE: Any oversized chunks should be shoveled to the side and recycled again.)

N. Turn shovel over and *place* material; do not throw it

O. Fill pothole above the level of existing pavement

EXAMPLES: If pothole is 2 inches deep, fill 3/4 inch to 1 inch above existing pavement. If pothole is 4 to 5 inches deep, fill 1 1/2 to 2 inches above existing pavement.

P. Stop producing material when pothole is nearly filled

Q. Compact material with vibrator-compactor or roller, if available, and/or drive truck tires over repaired pothole

R. Clean any leftover asphalt from road surface

S. Raise tray, shut off gas and burner valves, and raise jack

T. Travel to next job site

(NOTE: If moving only a short distance, engine and drum may be left running.)

U. Repeat procedure

JOB SHEET #5

V. At end of day, empty all material from drum

(NOTE: When only fines fall on tray, drum is nearly emptied.)

W. Shut down burners and valves

X. Cool down and clean unit

Y. Perform shut-down procedures

Z. Make final visual inspection; note and report any deficiencies to proper authorities

AA. Secure unit for travel

1. Lower and secure stack if applicable
2. Raise and secure tray
3. Close discharge door if applicable
4. Be sure *all* valves are *closed*

BB. Return to yard

ASPHALT RECYCLING MACHINES
UNIT XI

TEST

NAME ______________________________ SCORE ______________

1. Match terms associated with asphalt recycling machines to their correct definitions. Write the correct numbers in the blanks.

_____a. Degree or angle of tilt; measured from tongue-jack to burner on recycling machine

_____b. To keep or save materials that might be discarded or destroyed

_____c. Pressure measured in pounds per square inch

_____d. Accessory used for thawing frozen dirt and melting ice, for cleaning and heating tools, and for drying potholes and holes on bridge decks

_____e. Material left when asphalt burns and dries; to burn material onto a surface

_____f. Towed machine that heats and breaks up salvaged asphalt material or reheats prepared mix and returns it to a usable state for asphalt repair work

_____g. To make usable materials that might be discarded or destroyed

_____h. Small particles of material

1. psi
2. Torch
3. Asphalt recycling machine
4. Slope
5. Coke
6. Salvage
7. Fines
8. Recycle

2. Arrange in order stages in the asphalt recycling process. Write a "1" before the first stage, a "2" before the second stage, and so on.

_____a. Asphalt material falls through hot air, heats to between 250°F and 350°F, and returns to a usable state

_____b. Material goes into a rotating drum

_____c. Material drops through discharge door onto receiving tray and is ready to use

_____d. Chunks of salvaged asphalt material are shoveled into a hopper from a dump truck bed

_____e. Drum is tilted (sloped) so that material moves through the hot air and toward discharge door for a certain amount of time

_____f. Liquid propane gas (LPG) burners heat air inside drum to high temperatures (400°F to 750°F)

TEST

3. Match factors that affect production to their correct functions. Write the correct numbers in the blanks.

_____a. Mixes material and keeps it circulating through heat

_____b. Moves material through unit and determines the length of time material is exposed to heat

_____c. Heats material to optimum temperature so that it will make good patching material

_____d. Controls temperature ranges and burning quality of flame

1. Slope
2. Gas pressure
3. Temperature
4. Rate of rotation

4. Identify the parts of a heavy-duty asphalt recycling machine. Write the correct numbers in the blanks.

_____a. Loading chute

_____b. Temperature control valve

_____c. Burners and burner controls

_____d. Damper control

_____e. LPG tank

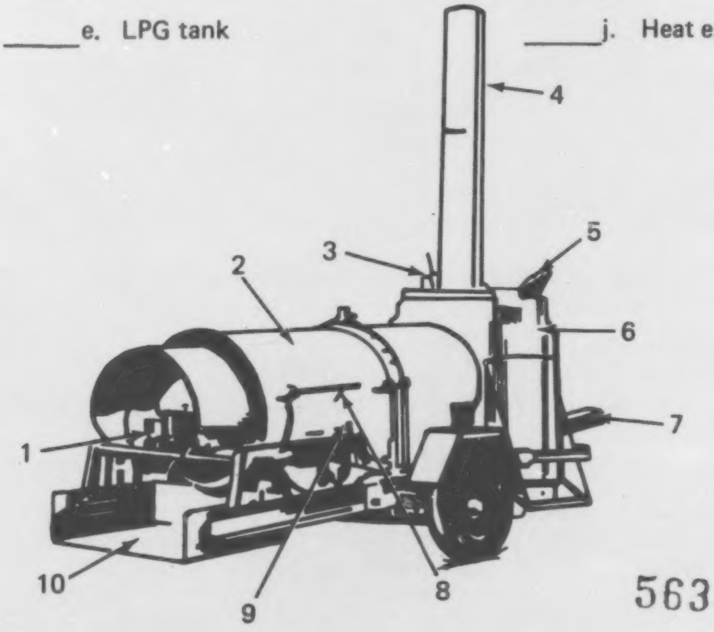
_____f. Towbar (with jack)

_____g. Drum

_____h. Receiving tray

_____i. Torch

_____j. Heat exhaust (stack)



TEST

5. Match controls on a heavy-duty asphalt recycling machine to their correct functions. Write the correct numbers in the blanks.

REAR END CONTROLS

_____ a. Controls gas flow to pilot burner

_____ b. Admit more oxygen to burner

_____ c. Indicates that igniter plug is creating sparks to ignite pilot burner

_____ d. Controls gas flow to right burner

_____ e. Starts or stops drum rotation

_____ f. Activates electrical spark ignition system

_____ g. Controls gas flow to left burner

_____ h. Controls gas flow from tank to main burners and pilot burner

_____ i. Permits pilot to burn until thermocouple is heated to operating temperature and burner will light

1. Pilot burner valve
2. Right burner valve
3. Main gas line valve
4. Left burner valve
5. Vents
6. Control key
7. Engine clutch
8. Spark circuit tester light
9. Red override button

STACK CONTROLS

_____ a. Opens gate to admit material; closes gate keep hot gases inside

_____ b. Controls air flow to flame in drum

_____ c. Secures smokestack in upright position

1. Damper
2. Stack latch bolt
3. Gate lever

OTHER CONTROLS

_____ a. Adjusts slope

_____ b. Shows degree of slope

_____ c. Start or stop engine; adjust drum rotation rate

_____ d. Selects desired temperature for mixing air in drum

_____ e. Controls gas flow from LPG tank to main gas lines

1. Temperature control (black knob)
2. Supply tank gas valve
3. Slope indicator
4. Engine controls
5. Jack

TEST

6. Identify the parts of a medium-duty asphalt recycling machine. Write the correct numbers in the blanks.

_____a. Drum

_____b. LPG tank

_____c. Temperature gauge

_____d. Drive clutch

_____e. Burner line

_____f. Pressure regulator

_____g. Engine controls

_____h. Heat exhaust

_____i. Door shield

_____j. Pressure gauge

_____k. Loading chute

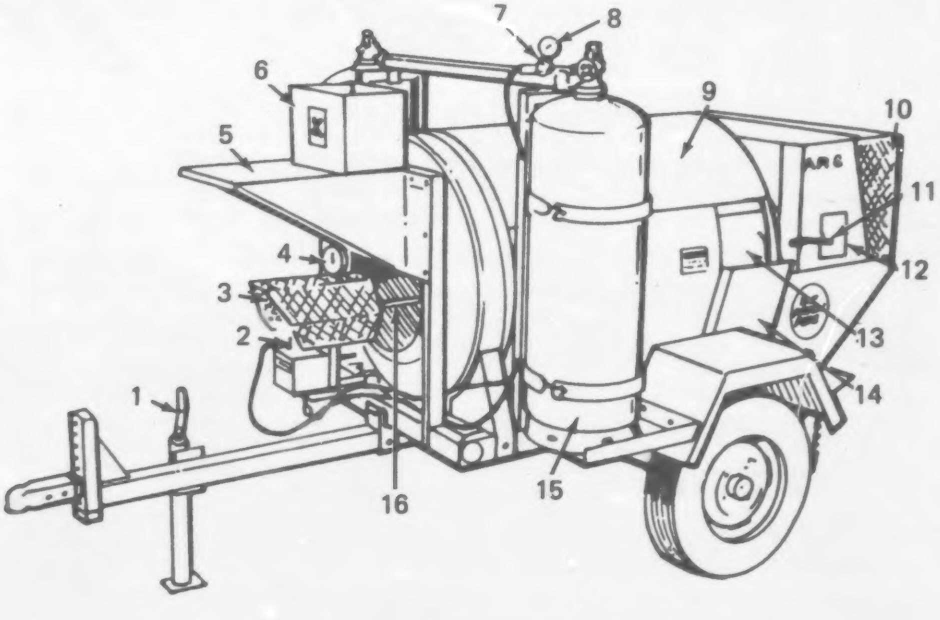
_____l. Gas valve

_____m. Jack

_____n. Engine guard

_____o. Discharge door

_____p. Spark ignition switch



TEST

7. Match controls on a medium-duty asphalt recycling machine to their correct functions. Write the correct numbers in the blanks.

_____a. Starts or stops drum rotation

_____b. Registers mixing air temperature in drum

_____c. Registers LPG pressure at tank

_____d. Controls engine speed and drum rotation speed

_____e. Provides electric spark to ignite gas burner

_____f. Adjusts slope

_____g. Adjusts gas flow to burner

_____h. Controls LPG pressure at tank

_____i. Start or stop engine

1. Pressure regulator
2. Throttle
3. Spark ignition switch
4. Gas valve
5. Pressure gauge
6. Drive clutch
7. Engine controls
8. Temperature gauge
9. Jack

8. State ten safety rules for operating an asphalt recycling machine.

a. ______________________________

b. ______________________________

c. ______________________________

d. ______________________________

e. ______________________________

f. ______________________________

g. ______________________________

h. ______________________________

i. ______________________________

j. ______________________________

9. State five procedures for safe burner operation.

a. ______________________________

b. ______________________________

c. ______________________________

TEST

d. ______________________________

e. ______________________________

10. Select from the following list causes of overheating. Write an "X" in the blank before each correct answer.

_____a. Incorrect drum size

_____b. Drum turning too fast

_____c. Too little slope

_____d. Too much material

_____e. Temperature too high

_____f. Gas pressure too low

_____g. Drum turning too slowly

_____h. Too much slope

11. Select from the following list procedures for effective asphalt recycling machine operation. Write an "X" in the blank before each correct answer.

_____a. Rather than running burners wide open, use a moderate flame over a longer period of time

_____b. Test recycled material for correct application temperature

_____c. Adjust drum rotation speed as needed to maintain proper temperature

_____d. Feed material into hopper at uniform rate

_____e. Perform all prestart inspection and maintenance procedures

_____f. Shovel out material from one place on tray

_____g. Be sure flames burn yellow with blue ends

_____h. Feed material until drum is full; let it empty out, and refill

_____i. Adjust slope often to maintain proper temperature

_____j. Adjust temperature as needed to keep material properly heated

_____k. Adjust towbar so that unit clears open tailgate

_____l. Run burners wide open as much as possible

TEST

_____m. Throw material from shovel to get a wide spread

_____n. Keep drum rotation constant at proper speed

_____o. Produce as much material as possible during operation

_____p. Be sure flames burn blue with yellow ends

_____q. Keep slope constant once it is properly adjusted

_____r. Place equipment as close to repair job as possible

_____s. Once temperature is set, keep it constant

_____t. Turn shovel over to place material

_____u. Allow a light carbon buildup in pilot and burner valves as insulation

_____v. Clean material off receiving tray occasionally

_____w. Keep drum fairly full

_____x. Know requirements for the machine you are using

_____y. If material cools on tray, use up cooled material before using hot material

12. Select from the following list operating procedures for a heavy-duty asphalt recycling machine. Write an "X" in the blank before each correct answer.

_____a. Add material slowly at first, then increase load

_____b. Adjust damper as needed for heating and maintaining temperature

_____c. Light burners before rotating drum

_____d. Set drum rotation so that material falls from a twelve o'clock position

_____e. Operate with damper closed as much as possible

_____f. Add material before preheating drum

_____g. Run left burner at a minimum flame (12 to 14 inches high); run right burner open

_____h. Replace jack handle after use

_____i. Rotate drum before lighting burners

_____j. Add material as fast as machine will take it

_____k. Use trial and error method to find best temperature and slope for material used

TEST

_____l. Preheat drum before adding material

_____m. Adjust tire pressure for amount of load

_____n. Reduce temperature when material is first added

_____o. Adjust temperature ten degrees at a time (one mark on dial) until material is at correct application temperature

_____p. Run right burner at a minimum flame (12 to 14 inches high); run left burner open

_____q. Increase temperature when material is added

_____r. Keep LPG pressure at 22 to 24 pounds per square inch (psi)

_____s. Set drum rotation so that material falls from a ten o'clock position

_____t. Adjust LPG pressure as needed to maintain correct temperature

13. Select from the following list operating procedures for a medium-duty asphalt recycling machine. Write an "X" in the blank before each correct answer.

_____a. Adjust discharge chute as needed for delivery and travel

_____b. Open discharge door as drum rotates toward you

_____c. Adjust temperature with gas valve and/or fuel pressure valve

_____d. Preheat unit to operating temperature

_____e. Stop drum rotation to open or close discharge door

_____f. Heat all materials to 600°F

_____g. Do not let temperature exceed 600°F

_____h. Adjust temperature with control dial

_____i. Do not run burner without rotating drum

_____j. Set drum rotation so that material falls from a two o'clock position

_____k. Set drum rotation so that material falls from a seven o'clock position

_____l. Use manufacturer's temperature chart for type of material being used

_____m. Do not let temperature exceed 400°F

_____n. Open and close discharge door by hand

_____o. Jack up burner end 3 to 5 inches

TEST

_____p. Do not let pressure exceed 50 pounds per square inch (psi)

_____q. Jack up burner end 4 to 8 inches

_____r. Light burners before rotating drum

_____s. Do not let heated drum remain empty for more than thirty seconds

14. Select from the following list procedures for torch operation. Write an "X" in the blank before each correct answer.

    _____a. Be sure torch is completely out before putting it on machine

    _____b. Bleed lines after shut-down

    _____c. Expose pilot to flame for only an instant

    _____d. Keep torch burning full strength

    _____e. Be sure torch is secure before moving unit

    _____f. Leave torch on the ground so that when unit is moved, it tears off and is left behind

    _____g. Hold pilot to flame for thirty seconds

(NOTE: Test question 15 lists the job sheets. They are an important part of this test. If they have not been completed, check with your instructor.)

15. Demonstrate the ability to

    a. Perform prestart inspection and maintenance procedures on an asphalt recycling machine.

    b. Service an asphalt recycling machine.

    c. Start, warm up, operate, clean, and shut down a heavy-duty asphalt recycling machine.

    d. Start, warm up, operate, clean, and shut down a medium-duty asphalt recycling machine.

    e. Repair potholes.

ASPHALT RECYCLING MACHINES
UNIT XI

ANSWERS TO TEST

1. a. 4
   b. 6
   c. 1
   d. 2
   e. 5
   f. 3
   g. 8
   h. 7

2. a. 4
   b. 2
   c. 6
   d. 1
   e. 5
   f. 3

3. a. 4
   b. 1
   c. 3
   d. 2

4. a. 5
   b. 9
   c. 1
   d. 3
   e. 6
   f. 7
   g. 2
   h. 10
   i. 8
   j. 4

ANSWERS TO TEST

5. REAR END CONTROLS

a. 1

b. 5

c. 8

d. 2

e. 7

f. 6

g. 4

h. 3

i. 9

STACK CONTROLS

a. 3

b. 1

c. 2

OTHER CONTROLS

a. 5

b. 3

c. 4

d. 1

e. 2

6. a. 9

b. 15

c. 4

d. 11

e. 16

f. 7

g. 12

h. 6

i. 14

j. 8

k. 5

l. 3

m. 1

n. 10

o. 13

p. 2

ANSWERS TO TEST

7. a. 6
   b. 8
   c. 5
   d. 2
   e. 3
   f. 9
   g. 4
   h. 1
   i. 7

8. Answer should include any ten of the following
   a. Read operator's manual thoroughly: know your machine
   b. Study departmental safety manual
   c. Wear clothing that can be easily removed and that fits closely enough not to get caught in moving parts
   d. Carry first-aid kit
   e. Place fire extinguisher where it can be easily reached
   f. Know the material you are using and the temperature range for that material
   g. Keep hands away from rotating drum
   h. Do not touch hot metal
   i. Be sure all guards and shields are in place and in good operating condition
   j. Stop engine before adding fuel or oil
   k. Do not leave unit running unattended
   l. Watch machine carefully for signs of overheating
   m. Do not allow material to overheat
   n. Clean recycler after each use

9. Answer should include any five of the following
   a. Before lighting pilots or burners, check and recheck to make sure that all valves are closed
   b. Use soapy water to check for leaks
   c. Before lighting pilots or burners, be sure that engine and drum are operating properly
   d. Rotate drum before lighting heaters

ANSWERS TO TEST

e. Stand to one side when lighting burners

f. If burners do not light instantly, shut down unit and clean burner valves

g. Bleed all gas lines and valves when shutting down unit

10. b, c, d, e, g

11. a, b, d, e, f, j, k, n, p, q, r, t, v, w, x

12. a, b, e, g, h, i, k, l, n, o, r, s

13. a, c, e, g, i, j, l, n, q, s

14. a, b, c, e

15. Performance skills evaluated to the satisfaction of the instructor

BRIDGE SNOOPER
UNIT XII

UNIT OBJECTIVE

After completing this unit, the student should be able to safely and effectively operate a bridge snooper. This knowledge will be shown by completing job sheets and unit test with a minimum score of 85 percent.

SPECIFIC OBJECTIVES

After completing this unit, the student should be able to

1. Match terms associated with bridge snoopers to their correct definitions.
2. Identify parts of a bridge snooper.
3. Select from a list principles of bridge snooper operation.
4. Match bridge snooper controls to their correct functions.
5. Match bridge snooper safety devices to their correct descriptions.
6. State safety rules for operating a bridge snooper.
7. State outrigger operating procedures.
8. State procedures used to prevent a bridge snooper from tipping over.
9. Select from a list procedures for effective bridge snooper operation.
10. Demonstrate the ability to
    a. Perform prestart inspection and maintenance procedures.
    b. Service a bridge snooper.
    c. Prepare snooper for operation (platform snooper).
    d. Operate controls (pivot snooper).
    e. Position platform and operate snooper (pivot snooper).
    f. Fold crane package and stow for travel (platform snooper).

BRIDGE SNOOPER
UNIT XII

SUGGESTED ACTIVITIES

I. Suggested activities

- A. Order materials planned to supplement unit.
    1. *Operation, Pedestal Frame.* Nine-page illustrated operating instructions. Available from Paxton-Mitchell Company, 2614 Martha Street, Omaha, Nebraska 68105, 402-345-6767.

       (NOTE: This is the script and photographs from a slide presentation. Paxton-Mitchell Company will make copy available to instructors.)
    2. Specific operators manuals for units students will operate.
- B. Provide students with objective sheet.
- C. Provide students with information and job sheets.
- D. Discuss unit and specific objectives.
- E. Discuss information sheet.
- F. Demonstrate and discuss procedures outlined in job sheets.
- G. Adapt Job Sheets #3-#6 for the snooper model(s) students will be using.

  (NOTE: The four Paxton-Mitchell snooper models commonly used are the pivot, basket, combination, and platform. Each model has a separate manual and different operating procedures. Be sure students have the correct manuals for the equipment they will be operating. Request additional copies from the manufacturer.)
- H. Stress safety devices and procedures that prevent snooper units from tipping over.
- I. Arrange a field trip for students to observe a snooper operation.
- J. Emphasize the need to work slowly and carefully.
- K. Take students to look at several types of bridges; discuss snooper operation on each.
- L. Make a model of the booms and platform; have students identify the control functions as you rotate, raise and lower, and scope the booms.

  (NOTE: Try to obtain a control panel from a salvaged snooper so that students may practice operating switches.)

SUGGESTED ACTIVITIES

M. Review rigging, Unit XVIII, for clamping procedures.

N. Give test.

O. Reteach if necessary.

II. Instructional materials

A. Objective sheet

B. Suggested activities

C. Information sheet

D. Job sheets

1. Job Sheet #1--Perform Prestart Inspection and Maintenance Procedures
2. Job Sheet #2--Service a Bridge Snooper
3. Job Sheet #3--Prepare Snooper for Operation (Platform Snooper)
4. Job Sheet #4--Operate Controls (Pivot Snooper)
5. Job Sheet #5--Position Platform and Operate Snooper (Pivot Snooper)
6. Job Sheet #6--Fold Crane Package and Stow for Travel (Platform Snooper)

E. Test

F. Answers to test

III. Unit references

A. *Equipment and Operating Specifications: Hydraulic Systems.* Omaha, Nebraksa: Paxton-Mitchell Company, n.d.

B. Lux, Donald G. et. al. *World of Construction.* Bloomington, Illinois: McKnight Publishing Company, 1982.

C. *Operation: Pedestal Frame.* Omaha, Nebraska: Paxton-Mitchell Company, n.d.

D. *Pointers on Operating.* Omaha, Nebraska: Paxton-Mitchell Company, n.d.

BRIDGE SNOOPER
UNIT XII

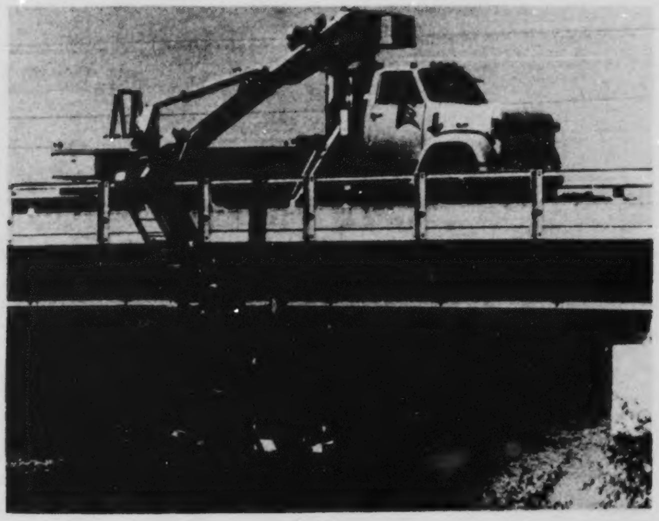
INFORMATION SHEET

I. Terms and definitions

A. Bridge snooper--Hydraulic crane and platform used to inspect, repair, and paint the undersides of high bridges (Figure 1)

EXAMPLE:

FIGURE 1



Courtesy of Paxton-Mitchell Company, Omaha, Nebraska.

B. Boom--Long arm that supports or guides an object to be lifted or swung

C. Crane package--Booms and platform

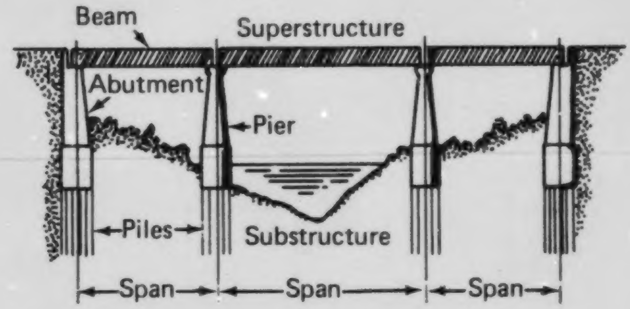
INFORMATION SHEET

D. Pier--Vertical bridge support (Figure 2)

E. Beam--Horizontal bridge support (Figure 2)

EXAMPLE:

FIGURE 2

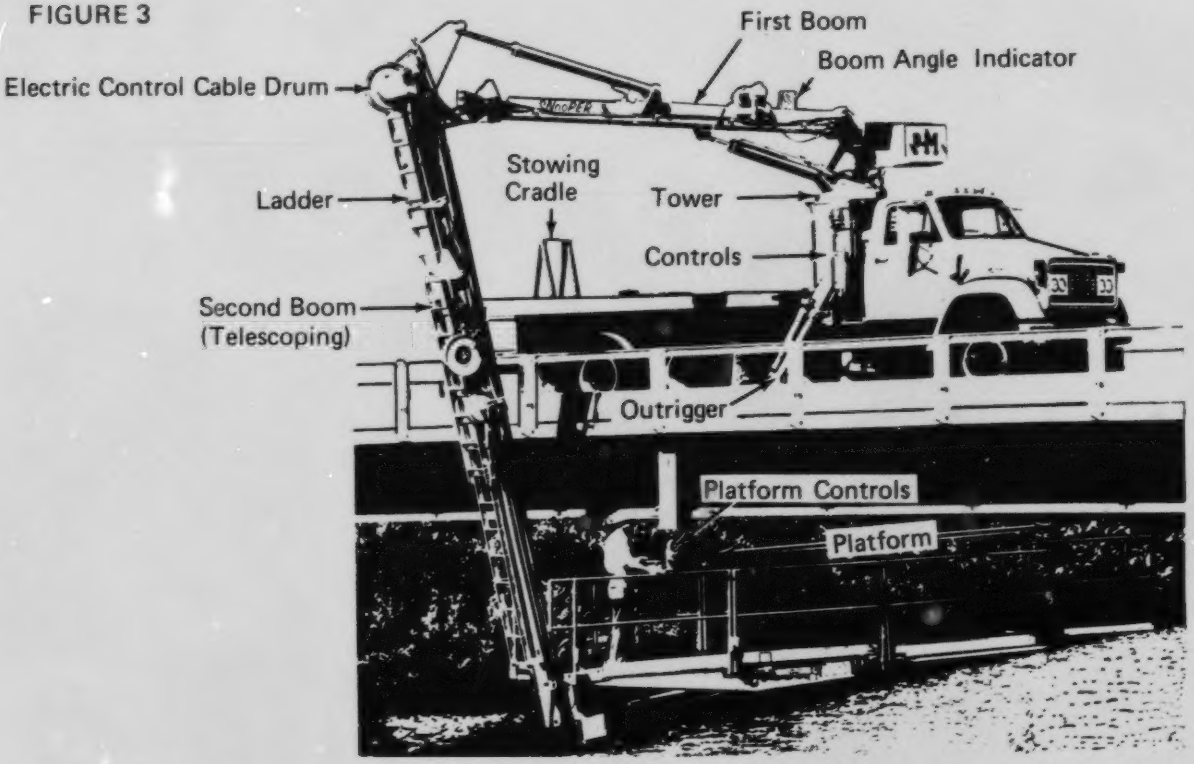

Beam
Superstructure
Abutment
Pier
Piles
Substructure
Span
Span
Span

INFORMATION SHEET

II. Parts of a bridge snooper (Figure 3)

(NOTE: The picture below illustrates a platform-type snooper. Basket, pivot, and combination snoopers will have slightly different equipment. Cradle supports boom when roading snooper.)

FIGURE 3


First Boom
Boom Angle Indicator
Electric Control Cable Drum
Stowing Cradle
Ladder
Tower
Controls
Second Boom (Telescoping)
Outrigger
Platform Controls
Platform

Courtesy of Paxton-Mitchell Company, Omaha, Nebraska.

INFORMATION SHEET

III. Principles of bridge snooper operation

A. A crane with two booms and a platform or buckets is mounted on truck bed

B. Entire crane package rotates on a tower

(NOTE: A counterweight system helps keep the truck from turning over. This unit can easily turn over when booms are extended.)

C. First boom tilts up or down, away from or toward truck bed

D. Second boom tilts toward or away from first boom, and telescopes in or out

E. Platform tilts toward or away from second boom

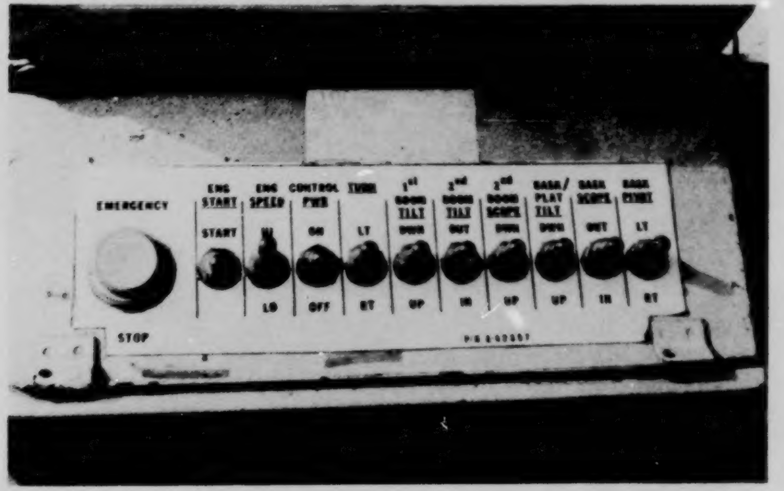
(NOTE: On some units, the platform also telescopes and rotates. Some units are equipped with extensions which increase the length of the platform.)

F. Three sets of controls can be used to operate unit

(NOTE: Electric controls are located at the control station and on the platform. Manually operated hydraulic controls are located directly behind the cab.)

EXAMPLE: Electric controls (Figure 4)

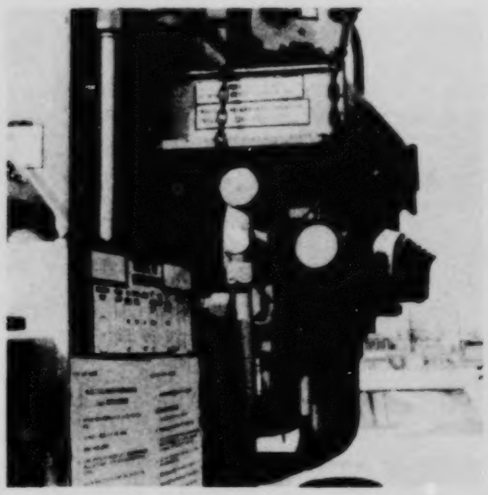
FIGURE 4


EMERGENCY
STOP
ENG START
START
ENG SPEED
HI
LO
CONTROL PWR
ON
OFF
TURN
LT
RT
1st BOOM TILT
DWN
UP
2nd BOOM TILT
OUT
IN
2nd BOOM SCOPE
DWN
UP
BASK/PLAT TILT
DWN
UP
BASK SCOPE
OUT
IN
BASK PIVOT
LT
RT

INFORMATION SHEET

EXAMPLE: Hydraulic controls (Figure 5)

FIGURE 5



G. Controls at operator's station override controls on platform

H. Intercoms mounted on platform and at control station keep inspector or worker in communication with operator at all times

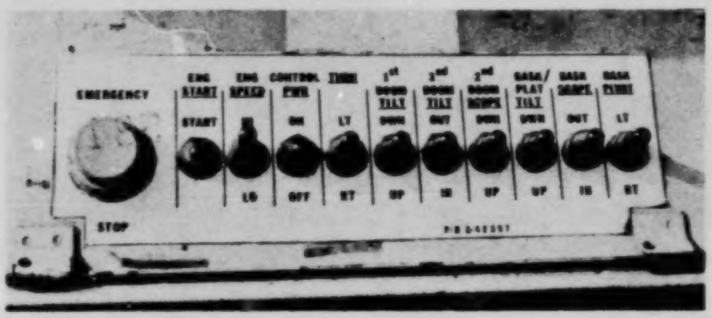
I. As work is completed at one bridge section, operator moves truck to next section

IV. Bridge snooper controls and their functions

(NOTE: Controls will vary with manufacturer and model. Figure 6 illustrates controls for a pivot snooper. Control panel on truck operator's station is the same as that on the platform or basket.)

EXAMPLE: Operating controls (Figure 6)

FIGURE 6


EMERGENCY
STOP
ENG START
START
ENG SPEED
LO
CONTROL PWR
ON
OFF
TURN
LT
RT
1st BOOM TILT
DOWN
UP
2nd BOOM TILT
OUT
IN
2nd BOOM SCOPE
DOWN
UP
BASK/PLAT TILT
DOWN
UP
BASK SCOPE
OUT
IN
BASK PIVOT
LT
RT

INFORMATION SHEET

A. Emergency stop--Shuts down truck engine

B. Engine start--Starts truck engine from operator's platform

C. Engine speed--Selects high or low gear range

(NOTE: Operate in high when adequate clearances allow safe operation; use low speed for close work where booms and basket move very slowly.)

D. Control power--Supplies power to function; must be activated before other boom control buttons will work

(NOTE: You must hold the control power switch in the ON position while you operate other switches.)

E. Turn--Rotates first boom at top of tower

F. 1st boom tilt--Raises or lowers first boom

G. 2nd boom tilt--Moves second boom away from or toward first boom

H. 2nd boom scope--Extends or retracts second boom

I. Basket/platform tilt--Moves platform into or away from second boom

J. Basket scope--Extends or retracts basket or platform

(NOTE: Only pivot and basket units scope.)

K. Basket pivot--Turns basket or platform to right or left

(NOTE: Platform will pivot almost full circle, from one side of the boom to the other. Not all units are equipped with basket/platform pivot controls.)

L. Outrigger control--Extends or retracts outriggers

(NOTE: Controls are located on each side of the tower for left and right outriggers.)

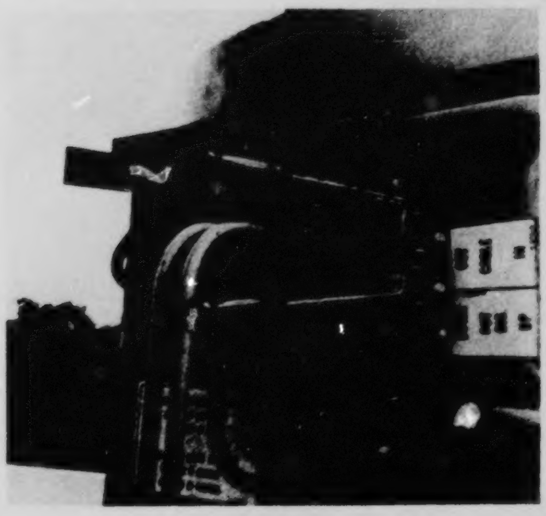
INFORMATION SHEET

M. Cable control--Operates winch (Figure 7)

(NOTE: Right outrigger and cable controls are located on passenger side of tower. Left outrigger and spring-lock controls are located on driver's side.)

EXAMPLE:

FIGURE 7



N. Master switch--Located in cab; turns on power to snooper

O. PTO control--Located in cab; transfers engine power to snooper hydraulic system

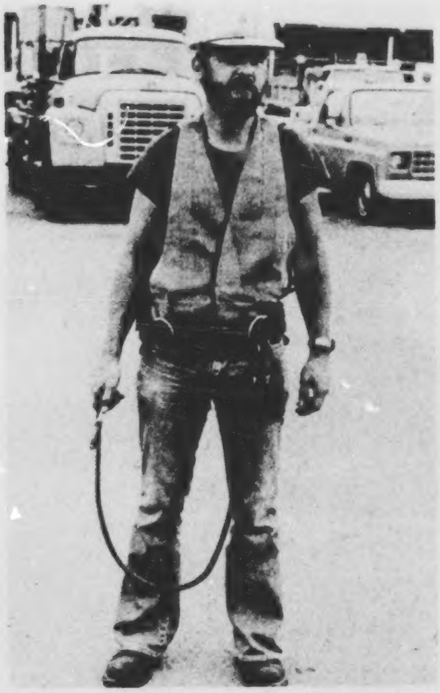
INFORMATION SHEET

V. Bridge snooper safety devices (Figures 8-11)

A. Safety harnesses--Secure personnel to platform or basket

EXAMPLE:

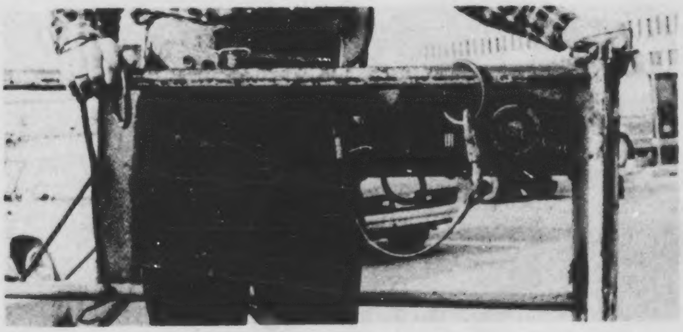
FIGURE 8



B. Safety belt rings--Secure safety harness to platform and allow movement

EXAMPLE:

FIGURE 9



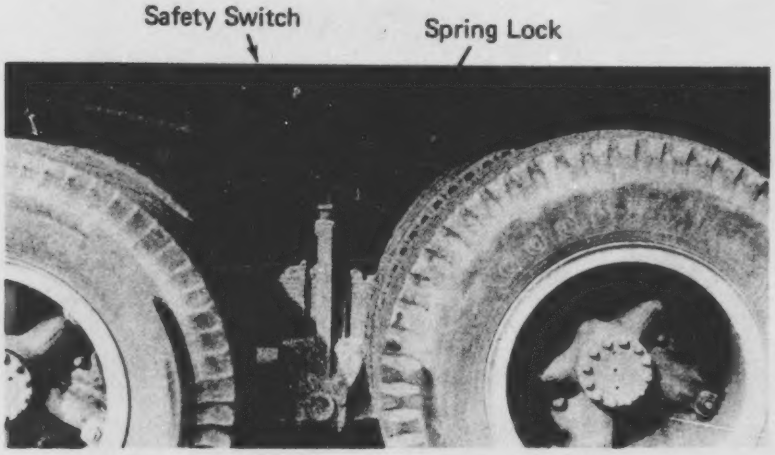
INFORMATION SHEET

C. Spring lock--Locks bed to rear differential; prevents bed from rocking sideways

(NOTE: There are two locks, one on each side.)

EXAMPLE:

FIGURE 10

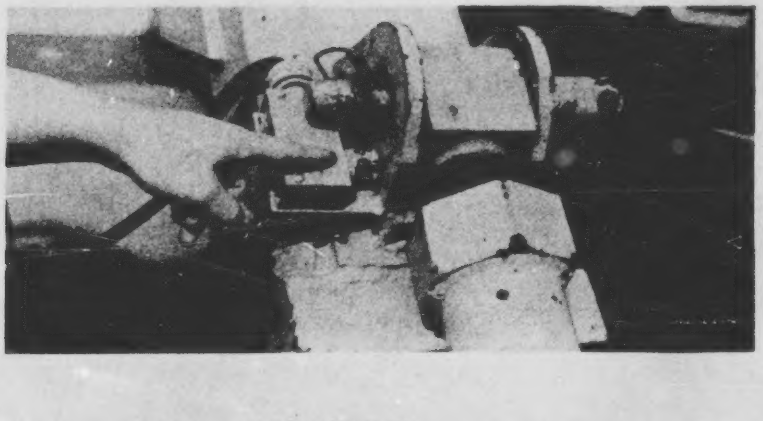


D. Spring-lock safety switch--Prevents boom controls from working if lock is not engaged (Figure 10)

(NOTE: Spring-lock control is located on the driver's side of the tower.)

E. Outrigger safety switch--Prevents boom controls from working unless outrigger and safety leg are properly extended so that switch is pushed in (Figure 11)

FIGURE 11



INFORMATION SHEET

F. First boom safety switch--Prevents second boom from telescoping (pivot and basket units only) until first boom is down, almost horizontal

G. Intercom--Keeps platform personnel and operator in touch at all times

H. Emergency stop switch--Shuts down truck engine immediately

I. Safety bars--Located on platform; must be secured with a cotter pin before operation

J. Fire extinguisher--Carried on truck; there is danger of fire from hydraulic fluid

K. First-aid kit--Carried on truck in case of injury

VI. Safety rules for operating a bridge snooper

(NOTE: When you operate a snooper, other people's safety depends on you. There is *no room for error.* Be very careful, conscientious, and alert at all times.)

A. Read operator's manual thoroughly: know your machine

B. Study departmental safety manual

C. NEVER leave your station

D. Know location and function of all controls

E. Be sure all safety devices are in good operating condition

F. Use traffic control devices

G. Do not overload platform or basket

(CAUTION: Overloading may cause snooper to turn over side of bridge.)

H. Be sure area is clear before moving outriggers

(NOTE: Be sure outriggers do not hit a person or an object as they are raised or lowered.)

I. Operate on level ground when possible

(CAUTION: Never exceed rating on unit.)

J. Secure control panel and safety bars before lowering platform

K. Be sure platform clears side of bridge before lowering it

L. If a line breaks and air gets into system, purge line after repair

(CAUTION: If there is any air in the system, clear personnel from the area before operating hydraulic equipment.)

M. Signal on intercom before moving truck

INFORMATION SHEET

N. Keep booms away from power lines

(CAUTION: Do not operate within 10 feet of power lines.)

(NOTE: The boom does not have to come in direct contact with wires to act as a conductor. If operating near power lines, power to lines should be shut off, or lines should be insulated. Double this distance if humidity is high.)

O. Do not let booms come in contact with utility lines attached to bridge

P. Avoid unnecessary booming up and down or telescoping

Q. Avoid jerky operations; handle controls smoothly

R. Keep center of weight of booms and platform as close to bridge as possible

VII. Outrigger operating procedures

(NOTE: These procedures are for the safety of the operator, personnel on the platform, and the unit. The outrigger braces the snooper against the ground and counteracts the weight of the extended boom.)

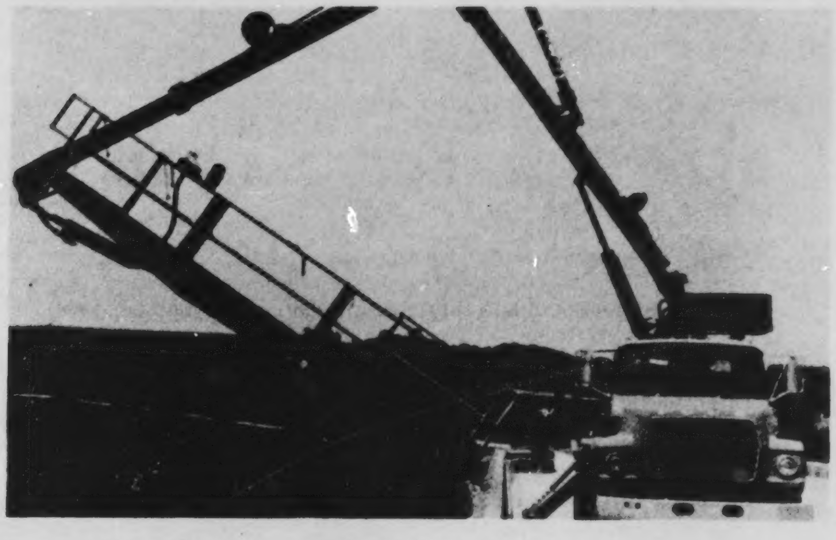
A. Be sure area is clear of personnel and obstacles before lowering or raising outriggers

B. Lower outrigger on boom side of truck before extending boom (Figure 12)

(NOTE: Booms will not rotate if outrigger and safety leg are not in place.)

EXAMPLE:

FIGURE 12



Courtesy of Paxton-Mitchell Company, Omaha, Nebraska.

INFORMATION SHEET

C. Do not move boom to side of truck which does not have outrigger in place

(CAUTION: If truck is not braced by the outrigger, it will turn over.)

D. Leave outrigger down when moving truck

E. Stow boom package before raising outriggers

(CAUTION: Never lift outrigger when booms are not stowed.)

VIII. Procedures used to prevent a bridge snooper from tipping over

(NOTE: The snooper *will* turn over if it is not correctly balanced, braced, and counterweighted. It is the operator's responsibility to keep the unit upright and prevent injury or death to the people on the platform.)

A. Set and check safety and bracing devices

EXAMPLES: Spring lockouts, outrigger, and manual safety leg

B. Do not add or subtract counterweights

C. Do not rotate boom to side of truck away from outrigger

D. Stow booms before raising outriggers

E. Do not overload platform or basket

F. Keep booms as close to bridge as possible during all operations

(NOTE: The greatest strain on the equipment occurs when the platform is extended outward, away from the bridge.)

G. Center boom over outrigger before raising or lowering platform

IX. Procedures for effective bridge snooper operation

(NOTE: An experienced snooper operator should work with you before you operate the unit. Be sure you have mastered controls before you operate the snooper with people on the platform.)

A. Perform all prestart inspection and maintenance procedures

B. Operate on level surface when possible; do not exceed rated slopes

(NOTE: If bridge is on a grade, operate uphill. Traveling uphill gives a smoother operation than traveling downhill, which strains the air brakes and causes jerky movement. This creates a hazard for the people on the platform.)

C. Pull truck forward as needed

(CAUTION: Be sure that platforms will clear piers.)

INFORMATION SHEET

D. Adjust booms and platforms gradually until they are correctly placed

E. Work slowly and smoothly

F. Stay by intercom for instructions and in case of emergency

BRIDGE SNOOPER
UNIT XII

JOB SHEET #1--PERFORM PRESTART INSPECTION AND MAINTENANCE PROCEDURES

I. Equipment and materials

- A. Bridge snooper
- B. Operator's manual
- C. Engine oil
- D. Engine coolant
- E. Hydraulic fluid
- F. Fuel
- G. Lubricants
- H. Grease gun
- I. Rags

II. Procedure

(NOTE: Deficiencies should be corrected immediately or reported to the proper authority. Do not operate defective equipment.)

- A. Make a walk-around visual inspection for leaks and broken, worn, or missing parts

  (NOTE: See operator's manual.)

- B. Check engine oil level; add or change engine oil if needed
- C. Check engine coolant level; add coolant if needed
- D. Check hydraulic reservoir level; add fluid if needed
- E. Check fuel level; fill tank if necessary
- F. Check battery connections for tightness and corrosion
- G. Check battery electrolyte level; add water if needed
- H. Check air cleaner; remove and clean filter if necessary
- I. Check brakes
- J. Check tires

JOB SHEET #1

K. Clean all grease fittings and lubricate according to operator's manual

L. Check hydraulic system for leaking lines and connections, bent or kinked lines, and lines rubbing against other parts

M. Check drive belts for tightness

N. Check electrical wire connections and insulation

O. Clean windshield and mirrors; adjust mirrors

P. Check gauges

Q. Check foot pedals for proper functioning

R. Check levers and controls for proper functioning

S. Remove trash

T. Check lights

U. Check safety devices

V. Check major components

(NOTE: See operator's manual.)

W. Check welds for cracks

BRIDGE SNOOPER
UNIT XII

JOB SHEET #2–SERVICE A BRIDGE SNOOPER

I. Equipment and materials

- A. Bridge snooper
- B. Operator's manual
- C. Tool kit
- D. Air supply
- E. Grease gun
- F. Lubricants
- G. Cleaning solvents
- H. Rags
- I. Water
- J. Engine coolant
- K. Engine oil
- L. Hydraulic fluid
- M. Transmission fluid
- N. Brake fluid
- O. Tire pressure gauge
- P. Fuel

II. Procedure

(NOTE: Follow departmental preventive maintenance program when servicing equipment. Refer to operator's manual for lubrication chart and for servicing specific components and attachments.)

A. Visually inspect for broken, worn, or missing parts; look for leaks

(NOTE: Major repairs and replacements should be reported to the proper authority and completed by a trained mechanic.)

B. Check engine oil level, filter, lines and hoses; add or change engine oil if needed

JOB SHEET #2

C. Check engine coolant level, radiator cap, hose, and radiator; add coolant if needed

(CAUTION: Do not remove radiator cap unless engine is cool; then open cap slowly to release pressure.)

D. Clean air filter; replace if necessary

E. Check fuel level, fuel filters, and sediment bowl (where applicable); fill fuel tank

F. Check battery electrolyte level, battery cables, and connectors; add water or electrolyte if needed

(CAUTION: Keep sparks and fire away from battery.)

G. Check exhaust system for loose connections or holes

H. Check hydraulic fluid level, filters, hose, lines, and fittings; look for leaks; add fluid if needed

I. Check transmission fluid level; add fluid if needed

J. Check transmission pressure line filter and breather

K. Check brake adjustment and condition; adjust if necessary

L. Check brake master cylinder fluid level;fill to level if necessary

M. Check clutch adjustment; adjust if necessary

N. Check drive belts for tension and wear; adjust or replace if necessary

O. Check wiring, insulation, and connections

P. Clean and lubricate all grease fittings according to operator's manual

Q. Check condition of tires

R. Check tire pressure; inflate to recommended pressure

S. Check safety line attachments; repair or replace if necessary

T. Check cables for fraying; replace if necessary

(CAUTION: Do not use frayed cable.)

U. Be sure that cable clamps have been properly installed

JOB SHEET #2

V. Check belts for fraying; replace if necessary

W. Check hooks for proper operation

X. Operate spring lockouts; check for proper operation

Y. Check oil level in the safety cylinder on second boom; fill to level

Z. Check functions by unfolding unit and using all controls at main station and remote station; watch for abnormal or faulty operation of each system

(CAUTION: Operate in an open area. Be sure outriggers and safety legs are down.)

AA. Check welds for cracks; remove paint and repair as needed

(NOTE: See operator's manual for location of welds.)

BB. Check bolts for proper torque according to operator's manual; adjust as needed

CC. Check condition and installation of boom, cylinder pins, locking bolts, and cotter pins according to operator's manual; replace if necessary

DD. Check ladder mounts, handrails, basket mounting, and basket for damage or cracks; repair or replace if necessary

EE. Check intercom for proper operation

FF. Check basket brake lock

BRIDGE SNOOPER
UNIT XII

JOB SHEET #3--PREPARE SNOOPER FOR OPERATION (PLATFORM SNOOPER)

(NOTE: This job sheet must be adapted for use with available equipment.)

I. Equipment and materials
  A. Bridge snooper
  B. Operator's manual
  C. Wheel blocks
  D. Traffic control devices
  E. Recommended safety equipment
    1. Hard hat
    2. Visible vest
    3. Fire extinguisher
    4. Safety belts
    5. Boat in water when working over water

II. Procedure
  A. Read operator's manual
  B. Perform all prestart inspection and maintenance procedures
  C. Place required traffic control devices
  D. Position truck on bridge between piers, about six feet from edge
  E. Set transmission at NEUTRAL
  F. Set brakes
  G. Block wheels
  H. Turn on master switch in truck
  I. Engage PTO
  J. Set spring lockouts at rear axles

     (NOTE: A cylinder shifts a pin horizontally to engage the lockout; vertical adjustment can be made to align the holes with a lock pin. Visually check to make sure the pin is engaged before operating.)

  K. Remove travel safety chains from outriggers

JOB SHEET #3

L. Lower outrigger on side where boom will be extended

M. Pivot manual safety leg into position and pin it in place; set cotter pin if machine is so equipped

(NOTE: On some units the pin is set automatically. This safety leg adds support for the outriggers. Do not fail to set it.)

N. Release hold-downs and chain locks on crane package

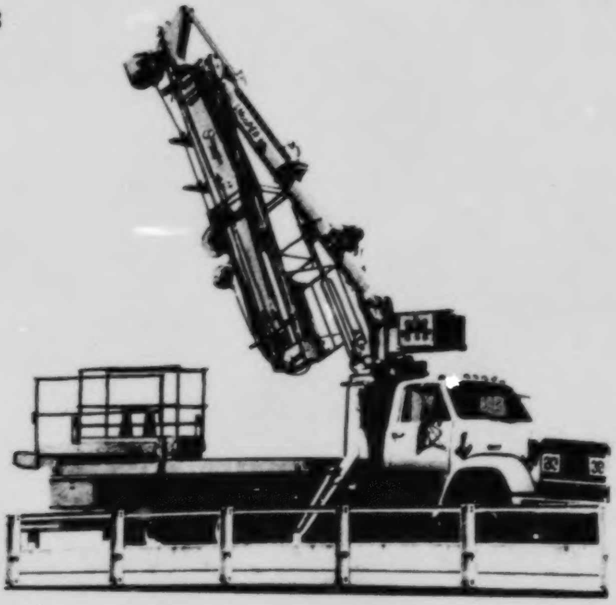
O. Take position at control panel at rear of cab

P. Hold CONTROL POWER switch in ON position and hold 1ST BOOM TILT switch in UP position

Q. Raise first boom to 45° angle (Figure 13)

(NOTE: Boom angle can be read on boom-angle indicator atop first boom.)

FIGURE 13



Used with permission of Paxton-Mitchell Company, Omaha, Nebraska.

R. Hold CONTROL POWER switch in ON position and hold TURN switch to rotate package slightly (±5°) to clear stowing cradle

(CAUTION: Keep crane over truck bed. Rotate toward the side with the outrigger support.)

S. Hold CONTROL POWER switch in ON position, and hold 2ND BOOM TILT switch in OUT position

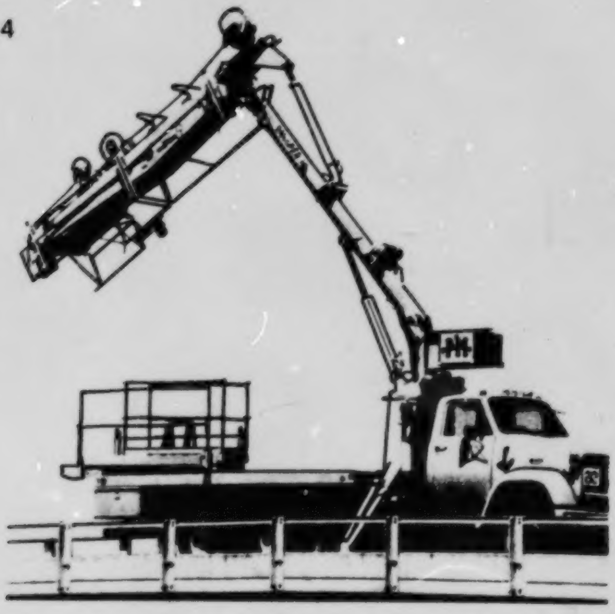
T. Move second boom out carefully, making sure boom tip clears obstructions on truck bed

JOB SHEET #3

U. Continue moving second boom out until it has reached its full outward travel (Figure 14)

(NOTE: When the second boom is fully tilted, it will form a 90° angle with the first boom.)

FIGURE 14



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V. Hold CONTROL POWER switch in ON position and hold BASKET/PLATFORM TILT switch in DOWN position

W. Tilt platform down until it is in horizontal position

X. Hold CONTROL POWER switch in ON position and hold 2ND BOOM SCOPE switch in DOWN position

Y. Scope second boom down to ground level or to truckbed level if using extension

Z. Set up handrails; secure with pins

AA. Secure control panel

BB. Hook up extension at this time if needed

(NOTE: See operator's manual for hook-up procedures.)

CC. Turn on intercom

(NOTE: The snooper is now ready for operation.)

BRIDGE SNOOPER
UNIT XII

JOB SHEET #4--OPERATE CONTROLS (PIVOT SNOOPER)

I. Equipment and materials

A. Bridge snooper in operating position with both outriggers down and wheels blocked

B. Operator's manual

II. Procedure

(NOTE: An experienced operator shall work with the student. Procedure should follow a safe and practical course according to the starting position of the booms and platform.)

A. Study control panel

B. Stop and start truck engine with controls

C. Hold CONTROL POWER switch in ON position while operating other switches

D. Operate selected switches by holding switch in desired direction (UP or DOWN, IN or OUT, LEFT or RIGHT) until boom or platform reaches the desired position

E. Release selected switch to CENTRAL or NEUTRAL position

F. Release *control power* switch to OFF position

G. Perform the following operations and repeat until you can place the booms and platform accurately

(NOTE: For operations 5 through 8, *be sure* first boom is tilted up and second boom is tilted out.)

1. Stop and start engine
2. Tilt first boom up and down
3. With first boom tilted up, tilt second boom out and in
4. Bring second boom close in to first boom; rotate package left and right

   (CAUTION: If both outriggers are not down, do not rotate to the side without an outrigger.)

5. Tilt first boom up, tilt second boom out, and then scope second boom out and in

   (CAUTION: Be sure first and second booms are tilted up and away from truck before scoping second boom out. Be sure you have clearance.)

6. With first boom tilted up and second boom tilted out, tilt platform down and up

7. Scope platform out and in if machine is so equipped

8. Pivot platform if machine is so equipped

H. Operate controls from platform station

I. Operate manual hydraulic controls

(NOTE: Handle should be secured to base of tower.)

1. Insert handle in control lever

2. Push up or pull down to select direction

BRIDGE SNOOPER
UNIT XII

JOB SHEET #5--POSITION PLATFORM AND OPERATE SNOOPER (PIVOT SNOOPER)

I. Equipment and materials

   A. Bridge snooper

   B. Operator's manual

II. Procedure

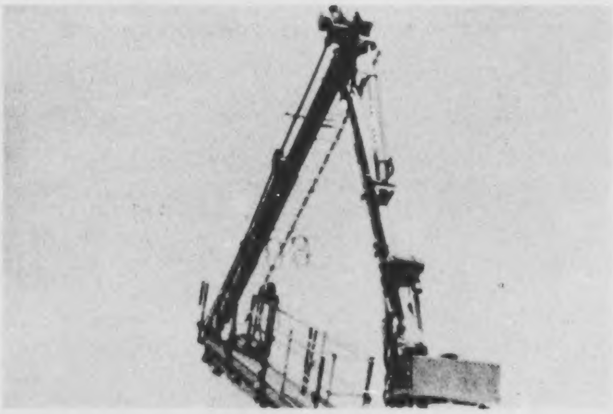
   A. Prepare snooper for operation

      1. Read operator's manual
      2. Perform prestart inspection and maintenance procedures
      3. Set spring lockouts, outrigger, and manual safety leg
      4. Release chains and load binders from cradle and first boom
      5. Unfold crane package
      6. Attach extension platform if needed
      7. Turn on intercom

   B. Tilt first boom up to 60° angle, tilt second boom out, and scope second boom up or down so that it is extended about six to eight feet (Figure 15)

   (NOTE: The platform will be positioned slightly down from the horizontal. The unit should be in this position before rotating the booms toward the outrigger.)

FIGURE 15



Courtesy of Paxton-Mitchell Company, Omaha, Nebraska.

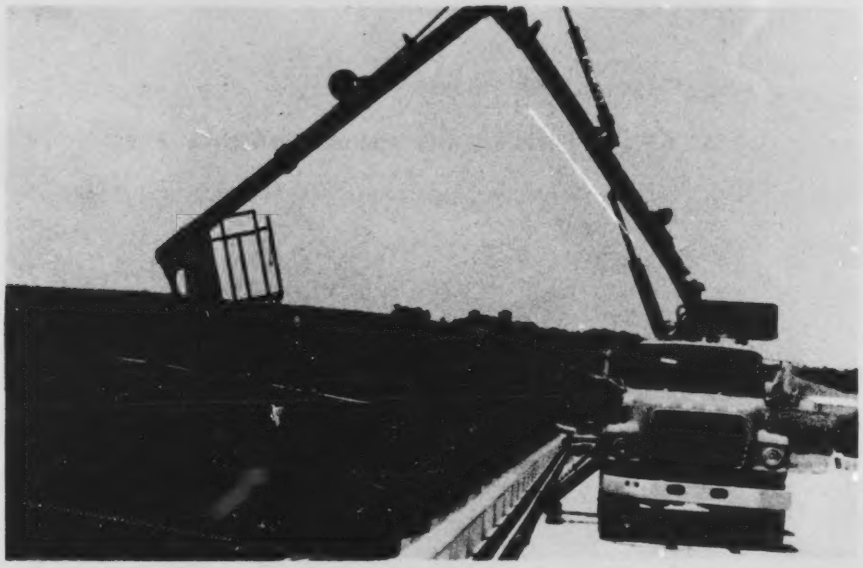
C. Rotate booms directly over outrigger

(CAUTION: Booms and platform should be held in as close as possible to the truck during all operations.)

D. Tilt second boom out so that platform will clear bridge railing when tilted down

E. Tilt platform so that it hangs down nearly vertical (Figure 16)

FIGURE 16



Courtesy of Paxton-Mitchell Company, Omaha, Nebraska.

F. Tilt second boom in so that platform stays near bridge deck

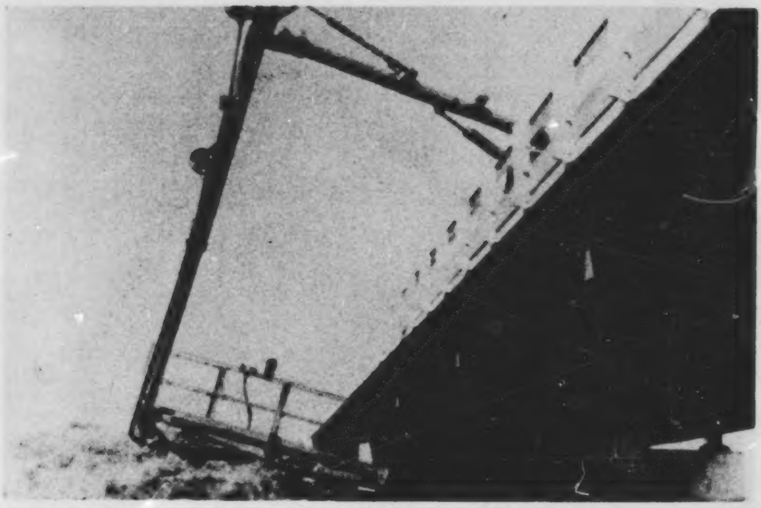
JOB SHEET #5

G. Tilt first boom down to work position (Figure 17)

(NOTE: As the first boom is tilted down, the platform and second boom will move in under the bridge deck. Be sure that there is adequate clearance under the bridge and that the platform will not hit a pier or beam. You may have to scope the second boom out for clearance.)

(CAUTION: Workers should not ride down on platform.)

FIGURE 17



Courtesy of Paxton-Mitchell Company, Omaha, Nebraska.

H. Use a series of short controlled movements to place platform where work is to be done

I. Level platform under bridge, with head clearance for workers

J. Rotate package toward rear so that second boom and ladder will be next to bridge deck

K. Signal workers when snooper is in position

L. Stand by controls and intercom during operation; listen for instructions and emergencies

(NOTE: In case of emergency, override platform controls by holding down power control switch. If electrical power should fail, insert handle in hydraulic controls, rotate package so workers can leave platform, raise and stow package.)

JOB SHEET #5

M. Remove wheel blocks if truck is to be moved along bridge during work period

(CAUTION: DO NOT HIT PIERS WHEN MOVING TRUCK. Be sure platform has enough clearance.)

N. Leave outrigger down when moving truck

BRIDGE SNOOPER
UNIT XII

JOB SHEET #6--FOLD CRANE PACKAGE AND STOW FOR TRAVEL (PLATFORM SNOOPER)

I. Equipment and materials

   A. Bridge snooper

   B. Operator's manual

II. Procedure

(NOTE: Persons on platform will signal the operator on the intercom when they are ready to leave the platform. They will rotate the booms so that the ladder is next to the side of the bridge, and they should remove all tools and objects from the platform when they return to the top.)

   A. Be sure all personnel and objects have been cleared from platform

   B. Block truck wheels if not already blocked

   C. Rotate unit so that booms are directly over outrigger

   D. Check for clearance around platform and adjust as needed to retract crane package

   E. Tilt second boom outward away from edge of bridge so that it is vertical or nearly vertical

   F. Tilt platform so it hangs down and clears bridge

   G. Tilt first boom up about 60°

   H. Tilt second boom out far enough so that tilted platform will clear rail

   I. Tilt platform up to horizontal position

   J. Scope second boom up above bridge rail

   K. Rotate package to rear of truck; center over bed

   L. Position platform either on ground or on truck bed so that you can get to it

   (NOTE: Use second boom scope, tilt controls, and platform tilt control.)

   M. Lower and secure handrails

   N. Remove or disconnect control panel if applicable

   O. Remove extension at this time if needed

   (NOTE: See operator's manual for procedure.)

   P. Tilt second boom out approximately 90° to first boom

JOB SHEET #6

Q. Scope second boom up all the way

(NOTE: Scoping the second boom up all the way prevents the end of the platform from striking the first boom.)

(CAUTION: Do not scope second boom unless first boom is tilted out and second boom is tilted out.)

R. Tilt first boom up high enough for clearance when platform is folded against second boom

S. Tilt first boom up high enough so that platform will clear obstructions when folded against second boom

T. Tilt second boom out all the way if it is not already out; then scope second boom up all the way

U. Tilt platform up against second boom (full closed position)

V. Tilt second boom in all the way

(CAUTION: Do not strike bed or objects on the bed with booms.)

W. Rotate unit so that boom package is directly over stowing cradle

X. Tilt first boom down until stowing bracket is over stowing cradle

Y. Use TURN CONTROL to center booms directly over cradle

Z. Tilt boom down until it rests on cradle

(CAUTION: Release switch as soon as boom is in position.)

AA. Tilt second boom out *slightly* (three or four inches) until it rests on truck bed

(CAUTION: Release switch as soon as boom is in position.)

BB. Hook chains and load binders; make sure package is secure on truck bed

CC. Retract spring lockouts

DD. Replace manual safety leg to its stowed position and secure it

EE. Retract outriggers and secure to truck with safety chains

FF. Remove wheel blocks

GG. Turn off main power switch in truck

HH. Disengage PTO

607

II. Return to yard or travel to next job site

BRIDGE SNOOPER
UNIT XII

TEST

NAME________________________________ SCORE ________________

1. Match terms associated with bridge snoopers to their correct definitions. Write the correct numbers in the blanks.

_____a. Vertical bridge support

_____b. Booms and platform

_____c. Hydraulic crane and platform used to inspect, repair, and paint the undersides of high bridges

_____d. Horizontal bridge support

_____e. Long arm that supports or guides an object to be lifted or swung

1. Crane package
2. Boom
3. Beam
4. Bridge snooper
5. Pier

TEST

2. Identify parts of a bridge snooper. Write the correct numbers in the blanks.

_____a. Platform

_____b. First boom

_____c. Second boom (telescoping)

_____d. Controls

_____e. Outrigger

_____f. Stowing cradle

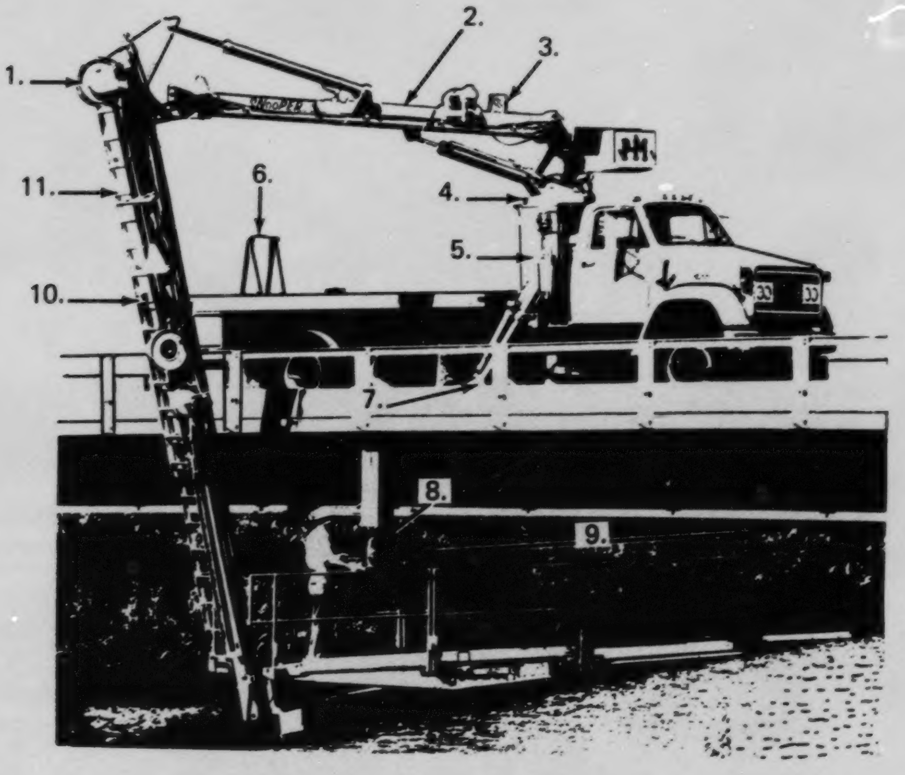
_____g. Ladder

_____h. Tower

_____i. Platform controls

_____j. Electric control cable drum

_____k. Boom angle indicator



TEST

3. Select from the following list principles of bridge snooper operation. Write an "X" in the blank before each correct answer.

______ a. Controls on platform override controls at operator's station

______ b. Platform tilts toward or away from first boom

______ c. Three sets of controls can be used to operate unit

______ d. First boom telescopes away from or toward the truck bed

______ e. Intercoms mounted on platform and at control station keep inspector or worker in communication with operator at all times

______ f. As work is completed at one bridge section, operator moves truck to next section

______ g. Platform tilts toward or away from second boom

______ h. A crane with two booms and a platform or buckets is mounted on truck bed

______ i. Two sets of controls can be used to operate unit

______ j. Controls at operator's station override controls on platform

______ k. First boom tilts up or down, away from or toward truck bed

______ l. Second boom tilts toward or away from first boom, and telescopes in or out

______ m. Second boom rotates toward or away from truck bed

______ n. Entire crane package rotates on a tower

4. Match bridge snooper controls to their correct functions. Write the correct numbers in the blanks. Terms and definitions are continued on the following page.

______ a. Moves second boom away from or toward first boom

______ b. Moves platform into or away from second boom

______ c. Operates winch

______ d. Shuts down truck engine

______ e. Raises or lowers first boom

______ f. Selects high or low gear range

______ g. Turns basket or platform to right or left

______ h. Supplies power to function; must be activated before other boom control buttons will work

1. Basket/platform tilt
2. Emergency stop
3. Cable control
4. 2nd boom tilt
5. Engine speed
6. Basket pivot
7. Control power
8. 1st boom tilt

TEST

_____i. Located in cab; turns on power to snooper

_____j. Rotates first boom at top of tower

_____k. Extends or retracts outriggers

_____l. Located in cab; transfers engine power to snooper hydraulic system

_____m. Extends or retracts basket or platform

_____n. Starts truck engine from operator's platform

_____o. Extends or retracts second boom

9. Turn
10. Basket scope
11. Engine start
12. 2nd boom scope
13. Outrigger control
14. Master switch
15. PTO control

5. Match bridge snooper safety devices to their correct descriptions. Write the correct numbers in the blanks.

_____a. Keeps platform personnel and operator in touch at all times

_____b. Carried on truck in case of injury

_____c. Prevents boom controls from working if lock is not engaged

_____d. Secure safety harness to platform and allow movement

_____e. Carried on truck; there is danger of fire from hydraulic fluid

_____f. Prevents boom controls from working unless outrigger and safety leg are properly extended so that switch is pushed in

_____g. Locks bed to rear differential; prevents bed from rocking sideways

_____h. Located on platform; must be secured with a cotter pin before operation

_____i. Secure personnel to platform or basket

_____j. Shuts down truck engine immediately

_____k. Prevents second boom from telescoping (pivot and basket units only) until first boom is down, almost horizontal

1. Spring lock
2. Safety belt rings
3. Safety bars
4. Fire extinguisher
5. Intercom
6. First boom safety switch
7. Emergency stop switch
8. Safety harnesses
9. First-aid kit
10. Spring-lock safety switch
11. Outrigger safety switch

TEST

6. State twelve safety rules for operating a bridge snooper.

a. ____
b. ____
c. ____
d. ____
e. ____
f. ____
g. ____
h. ____
i. ____
j. ____
k. ____
l. ____

7. State four outrigger operating procedures.

a. ____
b. ____
c. ____
d. ____

8. State procedures used to prevent bridge snooper from tipping over.

a. ____
b. ____
c. ____
d. ____
e. ____
f. ____
g. ____

TEST

9. Select from the following list procedures for effective bridge snooper operation. Write an "X" in the blank before each correct answer.

_____a. Pull truck forward as needed

_____b. Work quickly

_____c. Perform all prestart inspection and maintenance procedures

_____d. Rotate first boom around full circle before tilting second boom

_____e. Stay by intercom for instructions and in case of emergency

_____f. Listen to truck radio during operation

_____g. Ride down on platform to ensure correct placement

_____h. Adjust booms and platforms gradually until they are correctly placed

_____i. Work slowly and smoothly

_____j. Operate on level surface when possible; do not exceed rated slopes

_____k. Work for speed and learn to stop movement suddenly

_____l. Place truck facing downhill when possible

_____m. Take your date for a ride on the snooper

(NOTE: Question 10 lists the job sheets. They are an important part of this test. If they have not been completed, check with your instructor.)

10. Demonstrate the ability to

    a. Perform prestart inspection and maintenance procedures.

    b. Service a bridge snooper.

    c. Prepare snooper for operation (platform snooper).

    d. Operate controls (pivot snooper).

    e. Position platform and operate snooper (pivot snooper).

    f. Fold crane package and stow for travel (platform snooper).

BRIDGE SNOOPER
UNIT XII

ANSWERS TO TEST

1. a. 5
   b. 1
   c. 4
   d. 3
   e. 2

2. a. 9
   b. 2
   c. 10
   d. 5
   e. 7
   f. 6
   g. 11
   h. 4
   i. 8
   j. 1
   k. 3

3. c, e, f, g, h, j, k, l, n

4. a. 4
   b. 1
   c. 3
   d. 2
   e. 8
   f. 5
   g. 6
   h. 7
   i. 14
   j. 9
   k. 13
   l. 15
   m. 10
   n. 11
   o. 12

5. a. 5
   b. 9
   c. 10
   d. 2

ANSWERS TO TEST

e. 4

f. 11

g. 1

h. 3

i. 8

j. 7

k. 6

6. Answer should include any twelve of the following

   a. Read operator's manual thoroughly: know your machine

   b. Study departmental safety manual

   c. NEVER leave your station

   d. Know location and function of all controls

   e. Be sure all safety devices are in good operating condition

   f. Use traffic control devices

   g. Do not overload platform or basket

   h. Be sure area is clear before moving outriggers

   i. Operate on level ground when possible

   j. Secure control panel and safety bars before lowering platform

   k. Be sure platform clears side of bridge before lowering it

   l. If a line breaks and air gets into system, purge line after repair

   m. Signal on intercom before moving truck

   n. Keep booms away from power lines

   o. Do not let booms come in contact with utility lines attached to bridge

   p. Avoid unnecessary booming up and down or telescoping

   q. Avoid jerky operations; handle controls smoothly

   r. Keep center of weight of booms and platform as close to bridge as possible

7. Answer should include any four of the following

   a. Be sure area is clear of personnel and obstacles before lowering or raising outriggers

ANSWERS TO TEST

   b. Lower outrigger on boom side of truck before extending boom

   c. Do not move boom to side of truck which does not have outrigger in place

   d. Leave outrigger down when moving truck

   e. Stow boom package before raising outriggers

8. Answer should include the following

   a. Set and check safety and bracing devices

   b. Do not add or subtract counterweights

   c. Do not rotate boom to side of truck away from outrigger

   d. Stow booms before raising outrigger

   e. Do not overload platform or basket

   f. Keep booms as close to bridge as possible during all operations

   g. Center boom over outrigger before raising or lowering platform

9. a, c, e, h, i, j

10. Performance skills evaluated to the satisfaction of the instructor

SNOW BLOWER
UNIT XIII

UNIT OBJECTIVE

After completing this unit, the student should be able to safely and effectively operate a snow blower. This knowledge will be shown by completing the assignment sheet, job sheets, and unit test with a minimum score of 85 percent.

SPECIFIC OBJECTIVES

After completing this unit, the student should be able to

1. Match terms associated with snow blowers to their correct definitions.
2. Label the parts of a snow blower.
3. Identify controls on a typical snow blower.
4. Match snow blower controls to their correct functions.
5. Select from a list principles of snow blower operation.
6. State safety rules for operating a snow blower.
7. State procedures for effective snow blower operation.
8. Identify operating techniques for removing different types of snow.
9. Arrange in order steps to take when objects hit rotary.
10. Select from a list items to carry on unit.
11. Describe a snow removal operation.
12. Demonstrate the ability to
    a. Perform prestart inspection and maintenance procedures on a snow blower.
    b. Service a snow blower.
    c. Warm up, start, operate, and shut down a snow blower.
    d. Replace shear pins and fan blades.
    e. Operate a snow [illegible]ver in snow one to four feet deep.
    f. Operate a snow blower in snow over four feet deep.
    g. Clear snowbanks with a motor grader and snow blower.

SNOW BLOWER
UNIT XIII

SUGGESTED ACTIVITIES

I. Suggested activities

   A. Order materials to supplement unit.

      1. Film--*Cold Can Kill.* Color, 27 minutes, International Film Bureau Inc., 1972. Available from International Film Bureau Inc., 332 South Michigan Avenue, Chicago, Illinois 60604, (312) 427-4545.

         (NOTE: This film explains preventative measures for outdoor situations. It discusses proper clothing, insulation, equipment, waterproofing, and danger signs of hypothermia.)

      2. Operator's manuals for the equipment used.

   B. Provide students with objective sheet.

   C. Provide students with information, assignment, and job sheets.

   D. Discuss unit and specific objectives.

   E. Discuss information and assignment sheets.

   F. Demonstrate and discuss procedures outlined in job sheets.

   G. Provide alternate jobs if those in job sheets are not practical.

   H. Demonstrate operation of snow blower. Include faulty operations so that students can learn to recognize errors: Operate truck too slow and too fast; run with throttle half-open.

   I. Stress the need for safe driving techniques.

   J. Give test.

II. Instructional materials

   A. Objective sheet

   B. Suggested activities

   C. Information sheet

   D. Assignment Sheet #1--Describe a Snow Removal Operation

   E. Answers to assignment sheet

   F. Job sheets

      1. Job Sheet #1--Perform Prestart Inspection and Maintenance Procedures on a Snow Blower

      2. Job Sheet #2--Service a Snow Blower

SUGGESTED ACTIVITIES

3. Job Sheet #3--Warm Up, Start, Operate, and Shut Down a Snow Blower

4. Job Sheet #4--Replace Shear Pins and Fan Blades

5. Job Sheet #5--Operate a Snow Blower in Snow One to Four Feet Deep

6. Job Sheet #6--Operate a Snow Blower in Snow Over Four Feet Deep

7. Job Sheet #7--Clear Snowbanks with a Motor Grader and Snow Blower

G. Test

H. Answers to test

III. Unit references

A. *Construction Equipment Operator, Vol. 3: Operation of Base Maintenance and Auxiliary Construction Equipment.* Gunter Air Force Base, Alabama: U.S. Air Force, Extension Course Institute, 1972.

B. *Instruction and Maintenance Manual and Parts List for Snogo Model TU3.* Dubuque, Iowa: Klauer Manufacturing Company, n.d.

C. *Operation and Service Manual, FWD.* Clintonville, Wisconsin: FWD Corporation, n.d.

D. *Parts and Installation Manual: Blowers.* Kalamazoo, Michigan: Root Spring Scraper Co., n.d.

SNOW BLOWER
UNIT XIII

INFORMATION SHEET

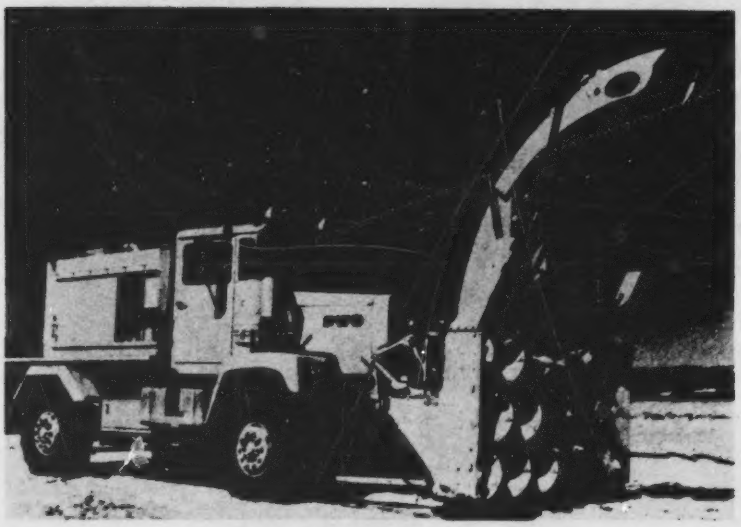
I. Terms and definitions

A. Snow blower--Truck-mounted blower unit used to remove deep snow and snowbanks; throws snow up and away from roadway (Figure 1)

(NOTE: May be mounted on a truck or front-end loader and can throw snow 150 feet or more.)

EXAMPLE:

FIGURE 1



Courtesy of Klauer Manufacturing Company.

B. Widening--Removing snowbanks built up by graders or plows

C. Windrow--Ridge of loose snow

D. Rotary--Blower unit

E. Shear pin--Pin designed to fail at a predetermined force in order to protect a mechanism

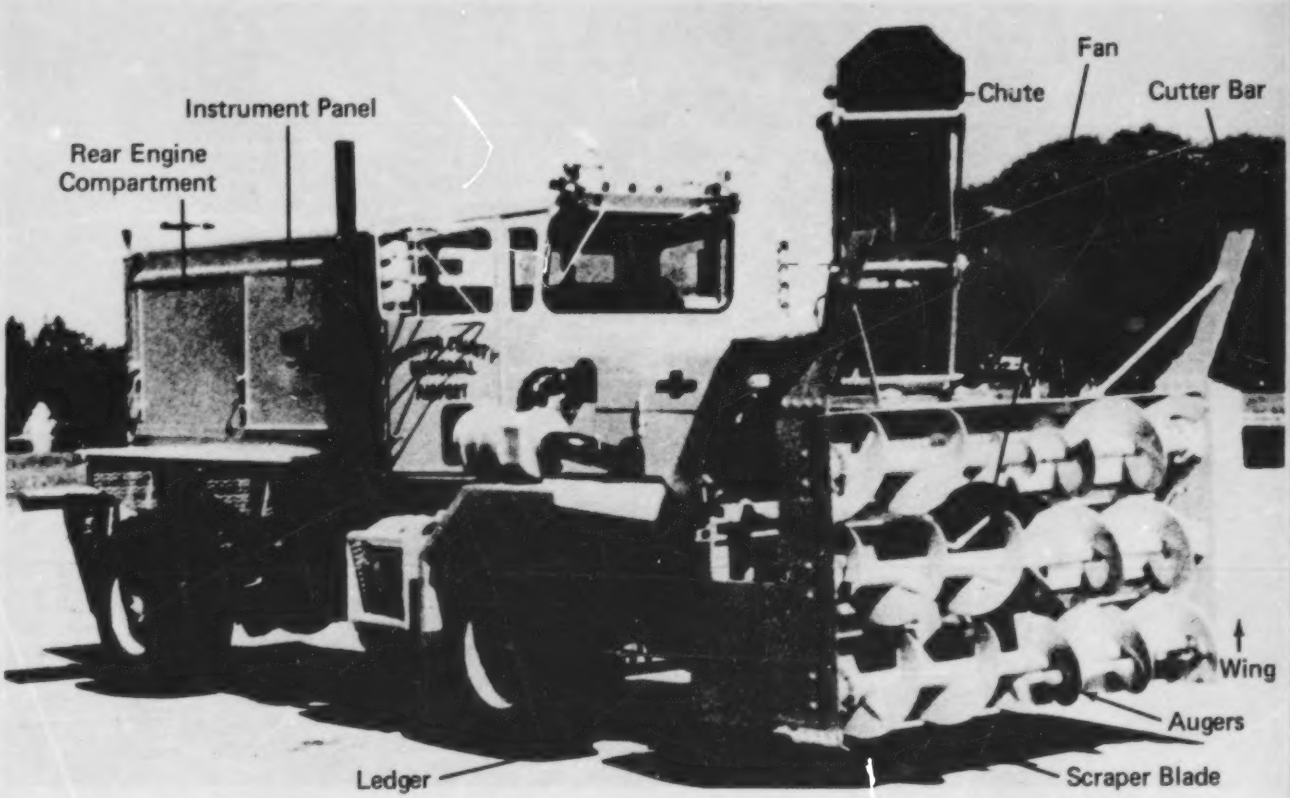
F. Eccentric--Off-axis rotation

(NOTE: Rotation is considered eccentric when rotary parts do not "run true.")

INFORMATION SHEET

Parts of a snow blower (Figure 2; Job Sheets #1 and #2)

FIGURE 2


Fan
Chute
Cutter Bar
Instrument Panel
Rear Engine Compartment
Wing
Augers
Ledger
Scraper Blade

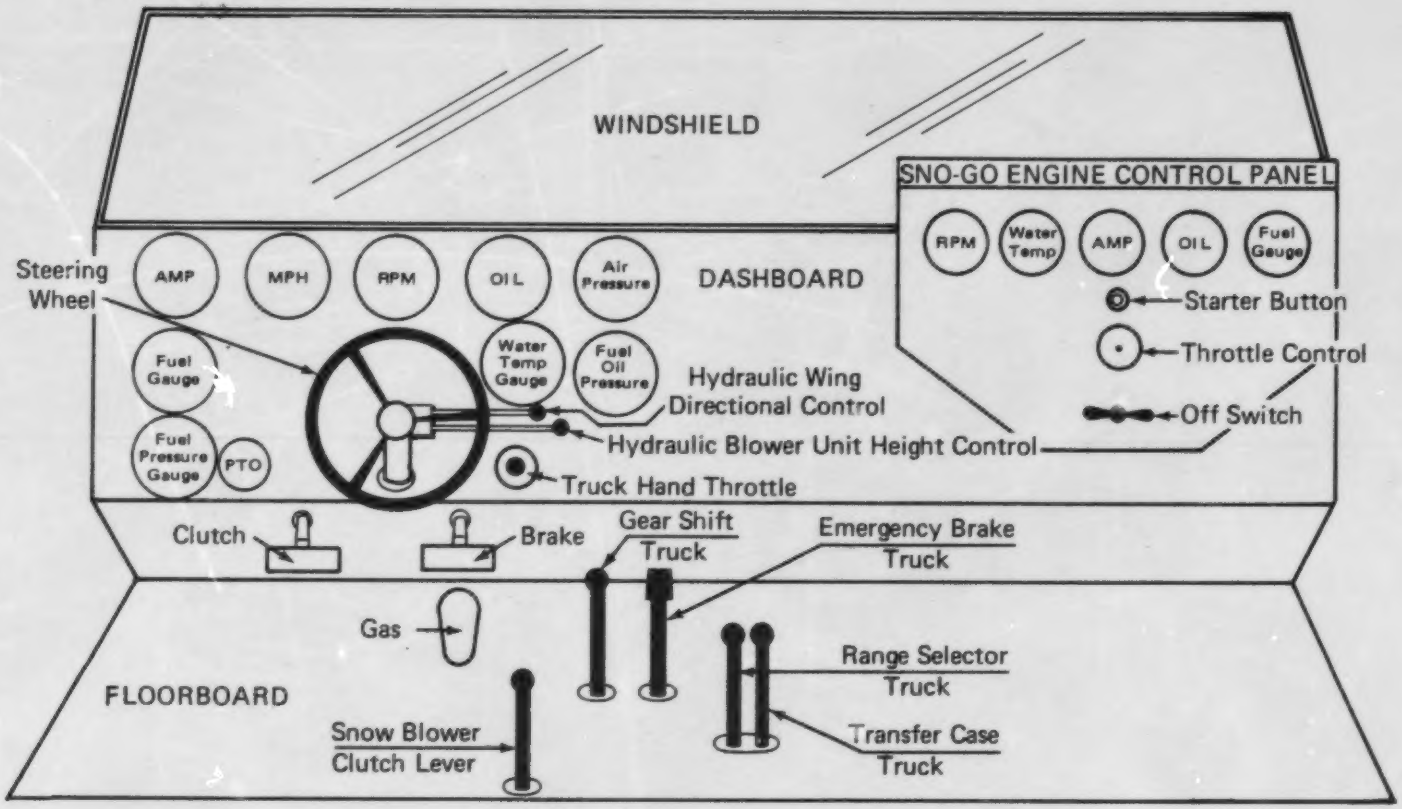
Courtesy of Klauer Manufacturing Company.

INFORMATION SHEET

III. Controls on a typical snow blower (Figure 3; Job Sheet #3)

(NOTE: Controls will vary with manufacturer and model.)

FIGURE 3


WINDSHIELD
SNO-GO ENGINE CONTROL PANEL
RPM
Water Temp
AMP
OIL
Fuel Gauge
Starter Button
Throttle Control
Off Switch
Steering Wheel
AMP
MPH
RPM
OIL
Air Pressure
DASHBOARD
Fuel Gauge
Water Temp Gauge
Fuel Oil Pressure
Hydraulic Wing Directional Control
Fuel Pressure Gauge
PTO
Hydraulic Blower Unit Height Control
Truck Hand Throttle
Clutch
Brake
Gear Shift Truck
Emergency Brake Truck
Gas
FLOORBOARD
Range Selector Truck
Transfer Case Truck
Snow Blower Clutch Lever

INFORMATION SHEET

IV. Snow blower controls and their functions

- A. Wing directional control--Operates hydraulic wings
- B. Height control–Raises and lowers blower unit
- C. PTO--Operates hydraulic accessories

  EXAMPLES: Wings, blower unit
- D. Clutch lever–Engages blower engine
- E. Control panel starter button--Cranks blower engine
- F. Engine control panel--Contains controls for blower engine
- G. Control panel hand throttle--Controls engine rpm for blower engine
- H. OFF-ON switch–Shuts down blower engine

  (NOTE: This switch must be in the ON position to start the engine.)

V. Principles of snow blower operation

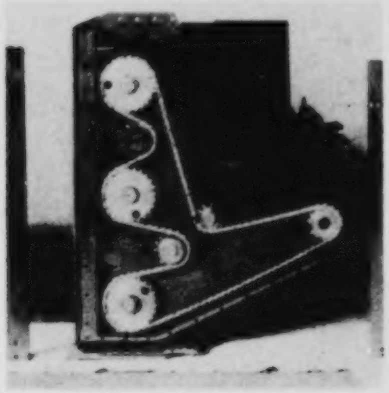
- A. Hydraulic rams raise or lower rotary unit
- B. Hydraulically operated wings guide unit through snow
- C. Blower engine powers augers and fan

INFORMATION SHEET

D. Drive chain turns augers (Figure 4)

EXAMPLE:

FIGURE 4

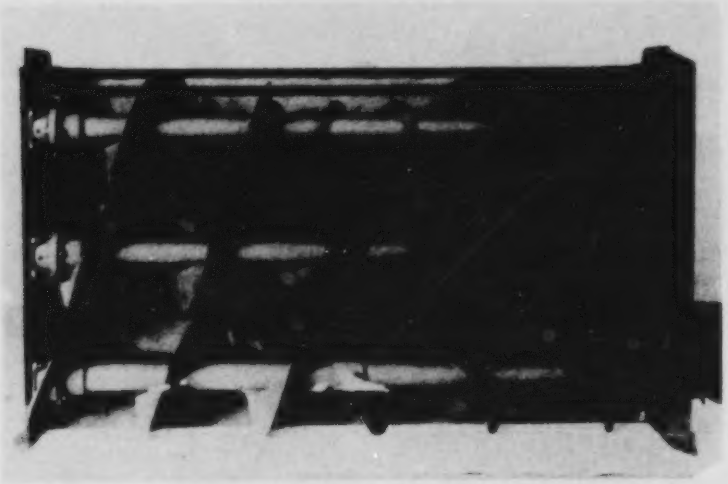


Courtesy of Klauer Manufacturing Company.

E. Augers break up snow and move it toward fan (Figure 5)

EXAMPLE:

FIGURE 5



Courtesy of Klauer Manufacturing Company.

F. Fan compresses snow and blows it out chute

(NOTE: Chute can be rotated to blow to right or left. Snow is usually blown to the right, away from the driver. Wind conditions, buildings, cars in the area, and other factors may affect direction of throw.)

G. Shear pins protect rotary from overstrain and severe damage

(NOTE: Pins will shear when foreign object gets caught in augers or fan blades. Engaging the blower clutch too fast, engaging it with the rear engine running too fast, or engaging it with the blower assembly clogged with snow will shear the pins.)

VI. Safety rules for operating a snow blower (Assignment Sheet #1)

A. Read operator's manual thoroughly: know your machine

B. Study departmental safety manual

C. Wear warm, close-fitting clothing and gloves

(CAUTION: Auger blades are sharp.)

D. Use flashing lights at all times

E. Attach SMV sign to rear of machine

F. Watch for obstructions and raise blade when approaching them

EXAMPLES: Signs, bridge expansion joints, cattle guards

G. When blowing windrows, be cautious of motor grader

H. Stop blower when near people, cars, or houses

(CAUTION: Blower can throw snow with rocks and other debris a distance of over 150 feet. Rocks and debris can be thrown with such force that they can break windows and can injure or even kill a person.)

I. Blow to open areas

(NOTE: Change direction of chute when near buildings, cars, or people.)

J. Carry extra winter gear in case of breakdown

K. Use extra caution in widening operations

(NOTE: Truck can slip off shoulder into washouts or cave-ins.)

INFORMATION SHEET

VII. Procedures for effective snow blower operation (Assignment Sheet #1; Job Sheets #1 and #4-#7)

(NOTE: Blower can be "slugged" by moving into snow drifts too fast. Blower will clog and break the shear pins. When truck speed is too slow, discharge will be foggy and blower will not operate at full capacity. Getting accustomed to the blower's capacity and power, and learning the most effective truck speed is essential for ease of operation and maximum snow removal.)

A. Perform all prestart inspection and maintenance procedures

B. Keep rotary operating at full capacity at all times

(NOTE: To operate the rotary at full capacity, the transmission gears should be shifted to a higher or lower speed according to the depth and density of the snow. Listen to the sound of the blower engine. It should not lug but should run with a good, even roar. Let the governor do the work.)

C. Keep throttle on blower unit wide open when removing snow

D. Maintain steady forward movement

(NOTE: Maintaining steady forward movement develops a full load for a constant discharge at all times.)

(CAUTION: Do not ram. Ramming into hard or frozen snow will cause pins to shear.)

E. Keep augers loaded to a maximum by forward speed of truck

(NOTE: Loading the augers provides the fastest snow removal and farthest and cleanest discharge. This is particularly important in shallow or wet snow. At the correct speed, snow will pulsate as it discharges.)

F. Use cutter bar as a sight guide in deep snow

G. Listen for objects striking rotary

EXAMPLES: Large rocks, car jacks, tow chains, tire chains

H. Watch for obstacles

(NOTE: If blower hits an object such as a sign post, guard rail, or mailbox, stop, put machine in reverse, and pull away from object as quickly as possible. Check blower unit for damage.)

I. Start at center and work toward shoulder

(NOTE: The snow blower will clear a lane about ten feet wide.)

INFORMATION SHEET

J. Drive with the flow of traffic

K. Keep as straight a line as possible

L. Drive five to seven mph, according to snow and road conditions

M. Cast snow stream with the wind if possible

N. Raise blower unit when operating close to shoulder

(NOTE: Likelihood of rocks is greater near the shoulder.)

O. Raise blower unit to clear axles when traveling

P. To begin snow removal, lower rotary until full weight is on road surface

(NOTE: This relieves weight on front axle.)

Q. Bring up both truck and blower engines to proper operating temperature before using in sub-zero weather

R. Perform all required maintenance

S. Keep machine clean

VIII. Operating techniques for removing different types of snow (Job Sheets #4-#7)

(NOTE: At all times, regardless of snow depth, the truck speed should be such that the rotary power unit is working at full capacity.)

A. Freshly fallen snow--Move forward in lowest gear until forward movement can be increased to get top performance from rotary

B. Hard, wind-driven snow--Move forward at slowest possible speed, letting scraper blade dislodge snow

(NOTE: Do not force augers into snow bank but permit them to eat their way through the frozen snow. If too much forward speed is used, the blower motor will stall. If snow is frozen to the ground, raise the blower above the frozen layer and remove the snow above it. Then back up and remove the frozen layer nearer the ground by shearing it with the scraper blade.)

C. Heavy, wet snow--Move forward at a speed that will keep the augers full

(NOTE: If the augers are not kept full of snow, the chute will choke up with snow. *Do not lunge* the rotary forward into wet snow as this will also cause choking. If choking occurs regularly, faster forward speed is needed. Increase forward speed briefly to fill augers, and then reduce speed to prevent motor from stalling.)

INFORMATION SHEET

D. Deep snow (snow drifted or higher than moldboard)--Drive straight into drift, remove several feet of snow, back straight out, then straight in again, repeating until area is cleared

(NOTE: When bottom layers are removed, top layers will collapse and may be removed on the second pass.)

(CAUTION: If cut is too deep, snow will collapse on the unit.)

E. Banked snow--Slice into bank, using one-half of auger unit, with open half picking up spillover

(NOTE: Banked snow must be cleared to widen roadway. This may be done with a motor grader and a snow blower. The motor grader cuts out a windrow and the snow blower removes it.)

(CAUTION: Widening can be dangerous. Snow is usually compressed and may contain foreign objects. Shoulders are covered and there is danger of slipping off the shoulder into washouts or cave-ins.)

Text in VIII used with permission of the Root Spring Scraper Company.

IX. Steps to take when objects hit rotary (Job Sheet #3)

(NOTE: The snow blower will pick up such objects as large rocks, tire chains, or tow chains buried in the snow. When the object hits the fan it may damage the fan blades. To prevent damage, the blower is equipped with shear pins that will break off and stop the rotary action. When the pins shear, rotary will fill with clogged snow that must be removed with a shovel.).

A. Stop *immediately*

B. Shut down rotary and remove object

(NOTE: When pins shear, rotate the auger backwards with gloved hand to free the object.)

C. Shovel snow from around augers

D. Inspect blower unit and fan carefully

E. Replace shear pins and fan blades as needed

(CAUTION: Do not overtighten shear pins.)

F. Check for erratic action of auger

EXAMPLES: Eccentric, distorted, or bent auger; damaged or bent moldboard; damaged auger bearings; split auger

INFORMATION SHEET

X. Items to carry on unit

A. Shear pins

(NOTE: Shear pins must be the correct size and type for your machine. Do not use hardened or heat-treated pins or bolts.)

B. Fan blades and bolts

C. Shovel

D. Flashlight

E. Tools

EXAMPLES: Wrenches, drift pin, hammer

F. Tire chains

SNOW BLOWER
UNIT XIII

ASSIGNMENT SHEET #1--DESCRIBE A SNOW REMOVAL OPERATION

NAME ______________________________ SCORE ______________

Use this assignment sheet to mentally practice a snow removal operation.

You will be removing three feet of heavy, wet spring snow from a state highway. Using what you have learned from the information sheets, answer the following questions.

A. What clothing will you wear?

1. ____
2. ____

B. What warning devices will you use on the unit?

1. ____
2. ____

C. What items will you carry with you in case an object hits the augers or fan?

1. ____
2. ____
3. ____
4. ____
5. ____

D. What technique will you use to remove the snow?

____

____

E. How will you know whether you are traveling at the correct speed?

1. ____
2. ____

F. What pattern will you use?

____

____

ASSIGNMENT SHEET #1

G. What will you do when you feel the unit strike an object such as a bridge rail?

1. ______________________________
2. ______________________________
3. ______________________________

H. What will you do when you hear an object such as a tire chain hit the augers?

1. ______________________________
2. ______________________________
3. ______________________________
4. ______________________________
5. ______________________________
6. ______________________________

I. What procedure will you use as you work toward the shoulder?

____

____

J. What will you do if the chute starts choking regularly?

____

____

K. You are blowing along the right shoulder and you see a cafe on the right-hand side of the road. What do you do?

____

____

L. You are blowing the center of the lane and you see a gas station on the left-hand side of the road and cars parked in front of a beer joint on the right-hand side. What do you do? (No, you can't pull into the beer joint.)

____

____

SNOW BLOWER
UNIT XIII

ANSWERS TO ASSIGNMENT SHEET

Assignment Sheet #1

A. 1. Warm, close-fitting clothes

   2. Gloves

B. 1. Flashing lights

   2. SMV emblem

C. 1. Shear pins

   2. Fan blades and bolts

   3. Shovel

   4. Flashlight

   5. Tools

D. Move forward at sufficient speed to keep the augers full

E. 1. Engine will operate at a good roar, with no lugging

   2. Snow will pulsate as it discharges

   (NOTE: Student may include or substitute for one of the above "snow will not clog in chute.")

F. Start in center, in the direction of traffic, and move toward shoulders on second pass

G. 1. Stop

   2. Put machine in reverse and pull away from object as quickly as possible

   3. Check blower unit for damage

ANSWERS TO ASSIGNMENT SHEET

H.
1. Stop immediately
2. Shut down rotary and remove object
3. Shovel snow from moldboard and augers
4. Inspect blower unit and fan carefully
5. Replace shear pins and fan blades as needed
6. Check for erratic action of auger

I. Raise blower

J. Increase speed

K. Turn chute to throw in another direction

L. Turn blower off

SNOW BLOWER
UNIT XIII

JOB SHEET #1--PERFORM PRESTART INSPECTION AND MAINTENANCE PROCEDURES ON A SNOW BLOWER

I. Equipment and materials

A. Snow blower

B. Operator's manual

C. Engine oil

D. Engine coolant

E. Hydraulic fluid

F. Fuel

G. Lubricants

H. Grease gun

I. Rags

II. Procedure

(NOTE: Deficiencies should be corrected immediately or reported to the proper authority. Do not operate defective equipment.)

A. Make a walk-around visual inspection for leaks and broken, worn, or missing parts

B. Check engine oil level; add oil if needed

C. Check engine coolant level; add coolant if needed

D. Check hydraulic reservoir level; add fluid if needed

E. Check fuel level; fill tank if necessary

F. Check battery connections for tightness and corrosion

G. Check battery electrolyte level; add water if needed

H. Check air cleaner; remove and clean filter if needed

I. Check brakes

J. Check tires

K. Clean all grease fittings and lubricate according to operator's manual

JOB SHEET #1

L. Check hydraulic system for leaking lines and connections, bent or kinked lines, and lines rubbing against other parts

M. Check drive belts for tightness

N. Check electrical wire connections and insulation

O. Clean windshield and mirrors; adjust mirrors

P. Check gauges

Q. Check foot pedals for proper functioning

R. Check levers and controls for proper functioning

S. Remove trash

T. Check lights

U. Check safety devices

V. Check major components

   1. Check auger drive chain for proper tension; adjust if necessary
   2. Check fan blades for bending or breakage; replace if necessary
   3. Check scraper blade bolts for tightness
   4. Check scraper blade for cracks or breaks
   5. Check fan rotor for bent or twisted arms; straighten or replace as needed
   6. Check fan gear case for lubricant level and leaks
   7. Check transfer chain lubricant level, and check for leaks
   8. Lubricate transfer chain, auger drive chain, and power take-off
   9. Check transfer chain for proper tension; adjust if necessary
   10. Check shear pins; replace if stretched

   (CAUTION: Use torque wrench if possible. Do not overtighten shear pins.)

SNOW BLOWER
UNIT XIII

JOB SHEET #2--SERVICE A SNOW BLOWER

I. Equipment and materials

   A. Snow blower

   B. Operator's manuals: Rotary unit, truck engine, auxiliary engine

   C. Tool kit

   D. Air supply

   E. Grease gun

   F. Lubricants

   G. Cleaning solvents

   H. Rags

   I. Water

   J. Engine coolant

   K. Engine oil

   L. Hydraulic fluid

   M. Transmission fluid

   N. Brake fluid

   O. Tire pressure gauge

   P. Fuel

II. Procedure for truck and auxiliary engine

(NOTE: Follow departmental preventive maintenance program when servicing equipment. Refer to operator's manual for lubrication chart and for servicing specific components and attachments.)

   A. Visually inspect for leaks and broken, worn, or missing parts

   (NOTE: Major repairs and replacements should be reported to the proper authority and completed by a trained mechanic.)

   B. Check engine oil level, filter, lines, and hoses; add engine oil if needed

C. Check engine coolant level, radiator cap, hoses, and radiator; add coolant if needed

(CAUTION: Do not remove radiator cap unless engine is cool; then, open cap slowly to release pressure.)

D. Check fuel level, fuel filters, and sediment bowl (where applicable); fill fuel tank if necessary

E. Clean air filter; replace if necessary

F. Check battery electrolyte level, battery cables, and connectors; add water if needed

(CAUTION: Keep sparks and fire away from battery.)

G. Check exhaust system for loose connections and holes

H. Check hydraulic fluid level, filters, hoses, lines, and fittings; look for leaks; add fluid if needed

I. Check transmission fluid level; add fluid if needed

J. Check transmission pressure line filter and breather

K. Check brake adjustment and condition; adjust if necessary

L. Check brake master cylinder fluid level; add fluid if needed

M. Check clutch adjustment; adjust if necessary

N. Check drive belts for tension and wear; adjust or replace if necessary

O. Check wiring, insulation, and connections

P. Clean and lubricate all grease fittings according to operator's manual

Q. Check condition of tires

R. Check tire pressure; inflate to recommended pressure

S. Check all safety devices; repair if necessary

T. Clean windshield and check windshield wipers; replace blades if necessary

III. Procedure for rotary unit

(NOTE: Refer to manual for specific maintenance procedures.)

A. Check auger drive chain for proper amount of slack; adjust tension if necessary

B. Check auger tubes for eccentric rotation caused by bent tubes; straighten with hammer if necessary

JOB SHEET #2

C. Check auger flights for dents and bending; straighten with hammer if necessary

D. Check scraper blade for cracks or breaks

E. Check scraper blade bolts for tightness

F. Check wear plates; replace if necessary

G. Check fan blades for bending or breakage; replace if necessary

H. Check fan rotor for bent or twisted arms; straighten or replace as needed

I. Check shear pins; replace if stretched

(NOTE: Use torque wrench if possible.)

(CAUTION: Do not overtighten shear pins.)

J. Check fan gear case for lubricant level and leaks

K. Check transfer chain for proper tension; adjust if necessary

L. Check transfer chain lubricant level, and check for leaks

M. Clean and lubricate all grease fittings as shown in operator's manual

N. Lubricate transfer chain, auger drive chain, and power take-off

O. Clean up all spills

SNOW BLOWER
UNIT XIII

JOB SHEET #3--WARM UP, START, OPERATE, AND SHUT DOWN A SNOW BLOWER

I. Equipment and materials

  A. Snow blower

  B. Operator's manuals

II. Procedure

  (NOTE: Refer to truck, auxiliary engine, and blower unit operator's manuals for specific procedures.)

  A. Set parking brake

  B. Place all truck controls in neutral position

  C. Turn on ignition

  D. Start blower engine at idle

  E. Allow both engines to warm up to operating temperature

  (NOTE: If chute is manually operated, set it so that snow will be thrown with the wind.)

  F. Increase blower engine speed slightly

  (NOTE: Increasing engine speed allows hydraulic system to operate efficiently.)

  G. Raise blower hydraulic control lever

  H. Remove lock pins

  I. Move blower hydraulic control lever down to lower blower unit

  (NOTE: Full weight of rotary should be on the ground. Truck front will rise slightly as weight of rotary is removed from springs. Hold hydraulic lever down until truck springs are fully released.)

  J. Throttle down blower engine

  K. Engage clutch remote-control lever *slowly* until fan and augers reach their relative speed

  L. Pull clutch lever all the way back until it snaps into running position

  (NOTE: Do not jerk lever in.)

  M. If machine is equipped with hydraulic chute control, set chute so that snow will be thrown with the wind

JOB SHEET #3

N. Open throttle slowly until engine is up to full governed speed

O. Select transmission speed according to snow conditions

(NOTE: Check operator's manual for recommended engine speed.)

P. Shift truck transmission into low gear and start forward; *keep blower operating at full engine load*

(NOTE: Shift transmission gears to a higher or lower speed according to the depth and density of snow. Listen to blower engine and watch discharge. If discharge is light and cloudy, forward speed is too slow. If engine lugs and rpm drops, load on engine is too heavy. At correct truck speed, engine should operate at a good roar, and snow discharge should pulsate.)

Q. Keep throttle wide open

R. Maintain steady forward movement

S. Stop truck at end of operation

T. Slowly disengage clutch remote-control lever

U. Reduce throttle to idle

V. Place transmission levers in neutral position

W. Set brake

X. Allow engines to idle three to five minutes to cool

Y. Shut down blower engine

Z. Shut down truck engine

AA. Move all levers to relieve hydraulic pressure

BB. Inspect auger and fan for damage

SNOW BLOWER
UNIT XIII

JOB SHEET #4–REPLACE SHEAR PINS AND FAN BLADES

I. Equipment and materials

  A. Truck-mounted snow blower

  B. Operator's manual

  C. Shear pins

  D. Fan blades

  E. Correct size mounting bolts and nuts

  F. Drift pin

  G. Wrenches

  H. Hammer

  I. Recommended safety and protective clothing

    1. Hard hat over ski cap or scarf

    2. Fur- or fleece-lined leather gloves

    3. Insulated close-fitting clothing

    4. Warm socks

    5. Insulated boots

  J. Four 4" x 4" x 18" wood blocks

II. Procedure

  A. Lower blower unit to rest on pavement

  B. Shut down engine and set emergency brake

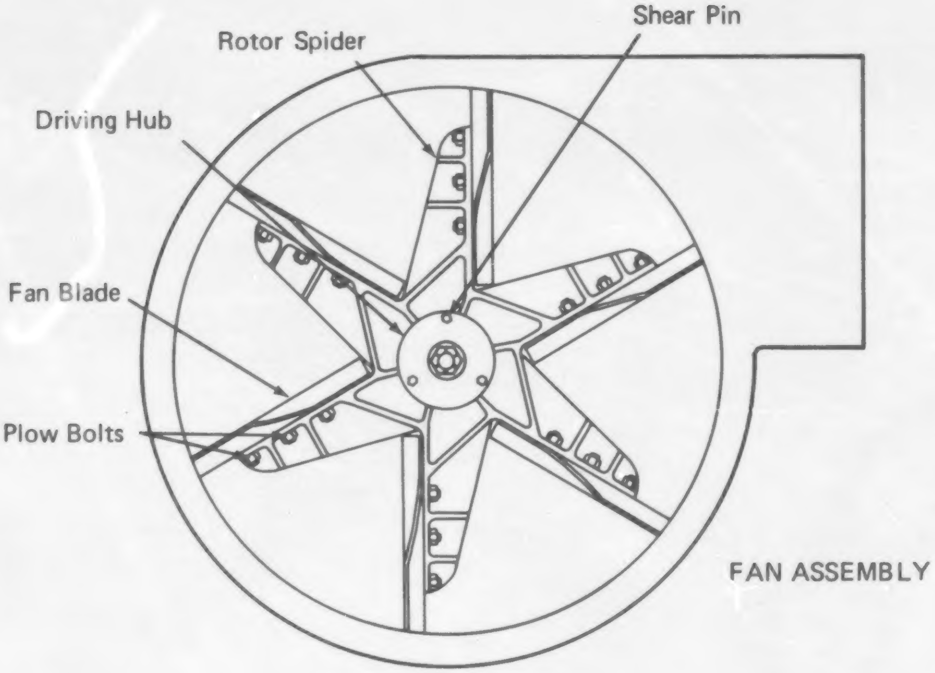
  C. Block rear wheels both front and back

  D. Clean snow from inside auger housing and around fan

JOB SHEET #4

E. Replace shear pins (Figure 6)

FIGURE 6


Shear Pin
Rotor Spider
Driving Hub
Fan Blade
Plow Bolts
FAN ASSEMBLY

Used with permission of Root Spring Scraper Company.

1. Remove pieces of shear pins
2. Align mounting holes in fan assembly hub with holes in driving hub

JOB SHEET #4

3. Insert a drift pin in one hole to get perfect alignment (Figure 7)

FIGURE 7

Courtesy of the Colorado Highway Department.

4. Insert shear pins in the two open holes with heads to front

5. Tighten bolts just enough to hold fan assembly

6. Remove drift pin and insert third shear pin

7. Tighten all three shear pins just enough to hold fan assembly snug against driving hub

   (NOTE: Do not overtighten shear pins or they will break.)

F. Replace fan blades

   1. Remove nuts and drive out bolts that secure fan blades to fan assembly

2. Position new blade so that holes align with holes in spider rotor (Figures 8 and 9)

FIGURE 8

Spider Rotor

FIGURE 9

Align Holes in Blade

Figures 8 and 9 courtesy of the Colorado Highway Department.

3. Insert bolts so that bolt heads are against fan blade

   (NOTE: These mounting bolts must be plow bolts.)

4. Tighten bolts to recommended torque

G. Store all tools and extra parts in their proper places

H. Remove blocks from rear wheels and store in unit

SNOW BLOWER
UNIT XIII

JOB SHEET #5--OPERATE A SNOW BLOWER IN SNOW ONE TO FOUR FEET DEEP

I. Equipment and materials

  A. Truck-mounted snow blower

  B. Operator's manual

  C. Extra fan blades, fan blade mounting bolts, shear pins

  D. Tool box with drift pin, wrenches, hammer

  E. Recommended safety equipment

    1. Hard hat over ski cap or scarf

    2. Fur- or fleece-lined leather gloves

    3. Insulated close-fitting clothing

    4. Wool socks

    5. Insulated boots

  F. Four 4" x 4" x 18" wood blocks

II. Procedure

(NOTE: It is possible that an object will hit the fan and the shear pins will release. If this happens, bring truck to a complete stop; shut down fan shaft, augers, and blower engine; block wheels and replace pins.)

  A. Make visual inspection of snow blower and truck

  B. Make necessary adjustments

  C. Mount truck in a safe manner

  D. Perform starting and warm-up procedures

  E. Raise auger housing to travel position and secure with safety device

  F. Drive to work area and position vehicles at starting point

  G. Set emergency brake

  H. Place gearshift lever in neutral

  I. Perform starting and warm-up procedures for blower unit

  J. Set chute so that snow will be blown into an open area if possible

  (NOTE: On some models, the chute is rotated manually; on others it is rotated hydraulically. Check operator's manual.)

JOB SHEET #5

K. Remove safety device; lower blower unit until skids rest on pavement

L. Activate augers

M. Activate blower fan

N. Bring blower engine to operating speed

O. Shift truck unit into low forward gear

P. Travel at speed and gear range appropriate for the conditions, five to seven mph

(NOTE: Engine speed will vary with conditions. Use slower engine speed for moving fluffy snow. Faster engine speed should be used in moving wet or compacted snow. Work from the center toward the shoulders.)

(CAUTION: Watch for obstructions such as sign posts, guard rails, boulders, and culvert headwalls.)

Q. Be prepared to stop immediately if an object should hit the fan

R. When first pass is completed, turn around and clear other side

S. Perform shut-down procedures for blower unit when job is completed

T. Raise auger housing to travel position and secure with safety device

U. Drive to safe parking area

V. Set emergency brake

W. Perform shut-down procedure for truck unit

X. Dismount in a safe manner

Y. Block rear wheels both front and back

Z. Make a visual inspection of the entire vehicle; write down any deficiencies and report them to the proper authority

SNOW BLOWER
UNIT XIII

JOB SHEET #6--OPERATE A SNOW BLOWER IN SNOW OVER FOUR FEET DEEP

I. Equipment and materials

- A. Truck-mounted snow blower
- B. Operator's manual
- C. Extra fan blades, fan blade mounting bolts, shear pins
- D. Tool box with drift pin, wrenches, hammer
- E. Recommended safety equipment
    1. Hard hat over ski cap or scarf
    2. Fur- or fleece-lined leather gloves
    3. Insulated close-fitting clothing
    4. Wool socks
    5. Insulated boots
- F. Four 4" x 4" x 18" wood blocks

II. Procedure

(NOTE: It is possible that an object will hit the fan and the shear pins will release. If this happens, bring truck to a complete stop; shut down fan shaft, augers, and blower engine; block wheels and replace pins.)

- A. Make a visual inspection of the snow blower and truck
- B. Make necessary adjustments
- C. Mount truck in a safe manner
- D. Perform starting and warm-up procedures
- E. Raise auger housing to travel height and secure with safety device
- F. Drive to work area and position vehicle at starting point
- G. Set emergency brake
- H. Place gearshift lever in neutral
- I. Perform starting and warm-up procedures for blower unit

JOB SHEET #6

J. Set chute so that snow will be blown into an open area if possible

(NOTE: On some models, the chute is rotated manually; on other models it is rotated hydraulically. Check operator's manual.)

K. Remove safety device; lower blower unit until skids rest on pavement

L. Activate augers

M. Activate blower fan

N. Bring blower engine to operating speed

O. Shift truck unit into low forward gear

P. Release emergency brake

Q. Drive straight into snow or drift a distance of four or five feet

(NOTE: When bottom layers are removed, top layers will collapse. They will be removed on the second pass.)

(CAUTION: If cut is too deep, snow will collapse on the unit.)

R. Stop truck, shift into reverse, and back straight out far enough to reposition truck six to eight feet to the right or left

S. Stop truck and shift into low forward gear

T. Reposition truck to right or left

(NOTE: Keep augers and blower fan operating during this procedure.)

U. Travel another four or five feet into snow bank; stop, shift to reverse gear, and back out as before

V. Be alert for objects striking the fan and for obstructions

(CAUTION: Watch for obstructions such as sign posts, guard rails, boulders, and culvert headwalls.)

W. Be prepared to stop immediately if an object should hit the fan

X. Continue removing small amounts of snow, backing out, and repositioning unit

Y. Shut-down blower unit when job is completed

Z. Raise auger housing to travel position and secure with safety device

AA. Drive to safe parking area

JOB SHEET #6

BB. Set emergency brake

CC. Shut-down truck unit

DD. Dismount in a safe manner

EE. Block rear wheels both front and back

FF. Make a visual inspection of the entire vehicle; write down any deficiencies and report them to the proper authority

SNOW BLOWER
UNIT XIII

JOB SHEET #7--CLEAR SNOWBANKS WITH A MOTOR GRADER AND SNOW BLOWER

I. Equipment, materials, and personnel

- A. Truck-mounted snow blower
- B. Operator's manual
- C. Extra fan blades, fan blade mounting bolts, shear pins
- D. Tool box with drift pin, wrenches, hammer
- E. Recommended safety equipment
  1. Hard hat over ski cap or scarf
  2. Fur- or fleece-lined leather gloves
  3. Insulated close-fitting clothing
  4. Wool socks
  5. Insulated boots
- F. Four 4" x 4" x 18" wood blocks
- G. Motor grader and operator

II. Procedure

(NOTE: It is possible that an object will hit the fan and the shear pins will release. If this happens, bring truck to a complete stop; shut down fan shaft, augers, and blower engine; block wheels and replace pins.)

- A. Make a visual inspection of snow blower and truck
- B. Make necessary adjustments
- C. Mount truck in a safe manner
- D. Perform starting and warm-up procedures
- E. Raise auger housing to travel height and secure with safety device
- F. Drive to work area
- G. Center snow blower over windrow at its starting point

  (NOTE: Grader operator will blade snow from the bank along the roadway toward the center of the road, forming a windrow four to six feet from the snowbank.)

JOB SHEET #7

H. Set emergency brake

I. Place gearshift lever in neutral

J. Perform starting and warm-up procedures for blower unit

K. Set chute so that snow will be blown into an open area if possible

(NOTE: On some models, the chute is rotated manually; on other models, it is rotated hydraulically. Check operator's manual.)

L. Remove safety device; lower blower unit until skids rest on pavement

M. Activate augers

N. Activate blower fan

O. Bring blower engine to operating speed

P. Shift truck unit into low forward gear

Q. Release emergency brake

R. Travel at speed and gear range appropriate for the conditions, five to seven mph

S. Continue until all of windrow has been removed

T. Deactivate augers and blower fans; shut down blower engine

U. Raise auger housing to travel height

V. Move truck clear of snow bank, so that motor grader can make another pass

W. Turn snow blower vehicle around and center it over new windrow

X. Repeat procedures H through S

Y. Continue windrowing and blowing snow until desired conditions are achieved

Z. Deactivate augers and blower fan; shut down blower engine

AA. Raise auger housing to travel height and secure with safety device

BB. Drive to safe parking area

CC. Set emergency brake

DD. Shut down truck unit

EE. Dismount in a safe manner

JOB SHEET #7

FF. Block rear wheels both front and back

GG. Make a visual inspection of the entire vehicle; write down any deficiencies and report them to the proper authority

SNOW BLOWER
UNIT XIII

TEST

NAME ______________________________ SCORE ______________

1. Match terms associated with snow blowers to their correct definitions. Write the correct numbers in the blanks.

_____a. Pin designed to fail at a predetermined force in order to protect a mechanism

_____b. Off-axis rotation

_____c. Truck-mounted blower unit used to remove deep snow and snowbanks; throws snow up and away from roadway

_____d. Removing snowbanks built up by graders or plows

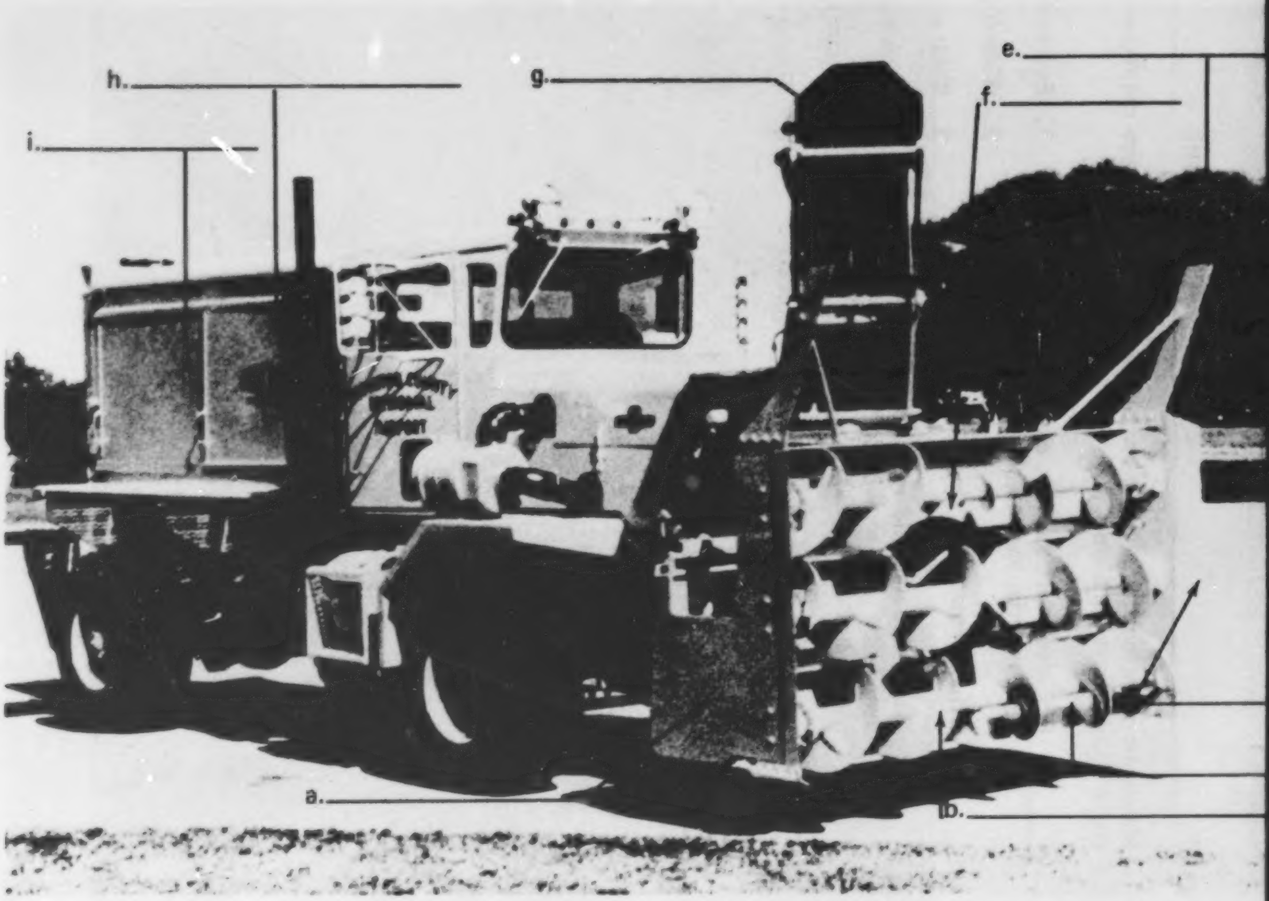
_____e. Blower unit

_____f. Ridge of loose snow

1. Eccentric
2. Widening
3. Shear pin
4. Snow blower
5. Windrow
6. Rotary

TEST

2. Label the parts of a snow blower. Write the correct names in the blanks.



TEST

3. Identify controls on a typical snow blower. Write the correct numbers in the blanks.

_____a. Starter button

_____b. Transfer case (truck)

_____c. Hydraulic blower unit height control

_____d. Snow blower clutch lever

_____e. Off switch

_____f. Truck hand throttle

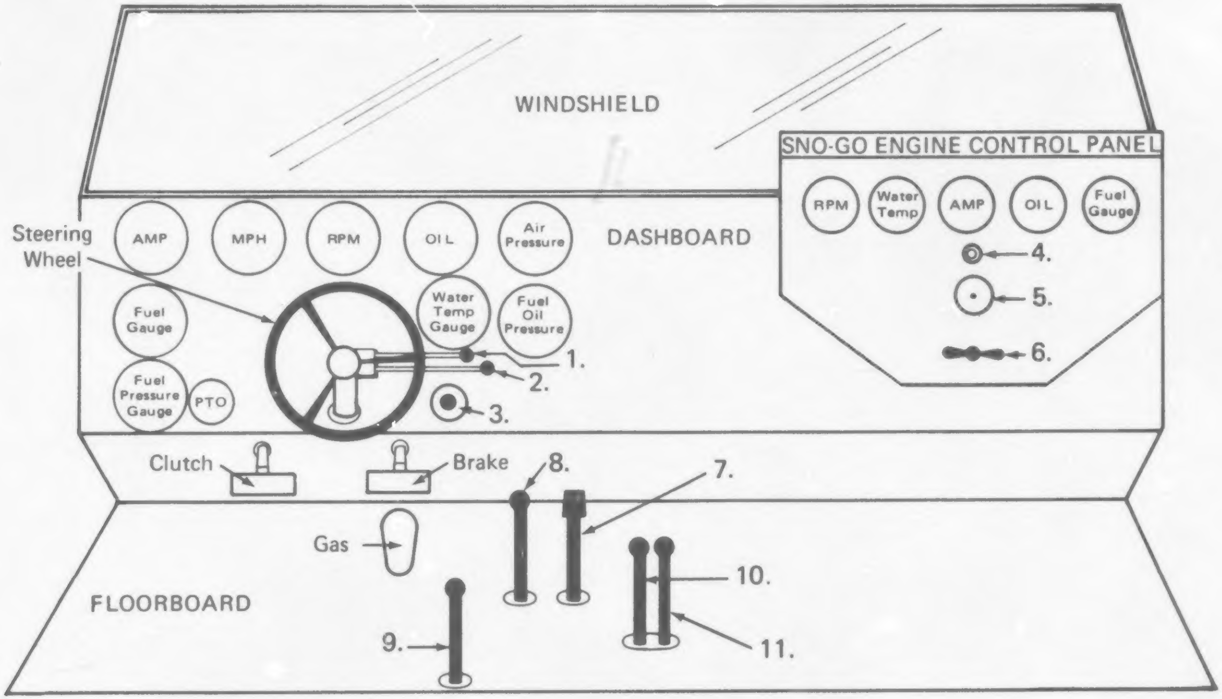
_____g. Emergency brake (truck)

_____h. Range selector (truck)

_____i. Throttle control

_____j. Hydraulic wing directional control

_____k. Gear shift (truck)


WINDSHIELD
SNO-GO ENGINE CONTROL PANEL
RPM
Water Temp
AMP
OIL
Fuel Gauge
4.
5.
6.
DASHBOARD
Steering Wheel
AMP
MPH
RPM
OIL
Air Pressure
Fuel Gauge
Water Temp Gauge
Fuel Oil Pressure
Fuel Pressure Gauge
PTO
1.
2.
3.
Clutch
Brake
8.
7.
Gas
10.
11.
9.
FLOORBOARD

TEST

. Match snow blower controls to their correct functions. Write the correct numbers in the blanks.

_____a. Engages blower engine

_____b. Shuts down blower engine

_____c. Operates hydraulic wings

_____d. Contains controls for blower engine

_____e. Controls engine rpm for blower engine

_____f. Raises and lowers blower unit

_____g. Operates hydraulic accessories .

_____h. Cranks blower engine

1. Control panel starter button
2. Control panel hand throttle
3. PTO
4. Height control
5. Clutch lever
6. OFF-ON switch
7. Wing directional control
8. Engine control panel

5. Select from the following list principles of snow blower operation. Write an "X" in the blank before each correct answer.

_____a. Plow forces snow into augers

_____b. Drive chain turns augers

_____c. Hydraulic rams raise or lower wings

_____d. Blower engine powers augers and fan

_____e. Shear pins protect rotary from overstrain and severe damage

_____f. Chute compresses snow

_____g. Hydraulically operated wings guide unit through snow

_____h. Fan breaks up snow and blows it out chute

_____i. Hydraulic rams raise or lower rotary unit

_____j. Augers break up snow and move it toward fan

_____k. Fan compresses snow and blows it out chute

_____l. Chute rotates and distributes snow

TEST

6. State six safety rules for operating a snow blower.

a. ______________________________

b. ______________________________

c. ______________________________

d. ______________________________

e. ______________________________

f. ______________________________

7. State twelve procedures for effective snow blower operation.

a. ______________________________

b. ______________________________

c. ______________________________

d. ______________________________

e. ______________________________

f. ______________________________

g. ______________________________

h. ______________________________

i. ______________________________

j. ______________________________

k. ______________________________

l. ______________________________

TEST

8. Identify operating techniques for removing different types of snow. Write the correct type of snow in the blanks.

Deep snow (snow drifted or higher than moldboard)	**Banked snow**
Hard, wind-driven snow	**Heavy, wet snow**
Freshly fallen snow	

_________________________a. Drive straight into drift, remove several feet of snow, back straight out, then straight in again, repeating until area is cleared

_________________________b. Move forward at slowest possible speed, letting scraper blade dislodge snow

_________________________c. Move forward at a speed that will keep the augers full

_________________________d. Slice into bank, using one-half of auger unit, with open half picking up spillover

_________________________e. Move forward in lowest gear until forward movement can be increased to get top performance from rotary

9. Arrange in order steps to take when objects hit rotary. Write a "1" before the first step, a "2" before the second step, and so on.

_____a. Shovel snow from around augers

_____b. Stop *immediately*

_____c. Check for erratic action of auger

_____d. Shut down rotary and remove object

_____e. Inspect blower unit and fan carefully

_____f. Replace shear pins and fan blades as needed

10. Select from the following list items to carry on unit. Write an "X" in the blank before each correct answer.

_____a. Flashlight

_____b. Tire chains

_____c. Tools

_____d. Shovel

_____e. Thermos of coffee

_____f. Fan blades and bolts

TEST

_____g. Kerosene

_____h. Auger chain

_____i. Shear pins

(NOTE: Test questions 11 and 12 list the assignment and job sheets. They are an important part of this test. If they have not been completed, check with your instructor.)

11. Describe a snow removal operation.

12. Demonstrate the ability to

    a. Perform prestart inspection and maintenance procedures on a snow blower.

    b. Service a snow blower.

    c. Warm up, start, operate, and shut down a snow blower.

    d. Replace shear pins and fan blades.

    e. Operate a snow blower in snow one to four feet deep.

    f. Operate a snow blower in snow over four feet deep.

    g. Clear snowbanks with a motor grader and snow blower.

SNOW BLOWER
UNIT XIII

ANSWERS TO TEST

1. a. 3
   b. 1
   c. 4
   d. 2
   e. 6
   f. 5

2. a. Ledger
   b. Auger
   c. Scraper blade
   d. Wing
   e. Cutter bar
   f. Fan
   g. Chute
   h. Instrument panel
   i. Rear engine compartment

3. a. 4
   b. 11
   c. 2
   d. 9
   e. 6
   f. 3
   g. 7
   h. 10
   i. 5
   j. 1
   k. 8

4. a. 5
   b. 6
   c. 7
   d. 8
   e. 2
   f. 4
   g. 3
   h. 1

ANSWERS TO TEST

5. b, d, e, g, i, j, k

6. Answer should include any six of the following
   - a. Read operator's manual thoroughly: know your machine
   - b. Study departmental safety manual
   - c. Wear warm, close-fitting clothing and gloves
   - d. Use flashing lights at all times
   - e. Attach SMV sign to rear of machine
   - f. Watch for obstructions and raise blade when approaching them
   - g. When blowing windrows, be cautious of motor grader
   - h. Stop blower when near people, cars, or houses
   - i. Blow to open areas
   - j. Carry extra winter gear in case of breakdown
   - k. Use extra caution in widening operations

7. Answer should include any twelve of the following
   - a. Perform all prestart inspection and maintenance procedures
   - b. Keep rotary operating at full capacity at all times
   - c. Keep throttle on blower unit wide open when removing snow
   - d. Maintain steady forward movement
   - e. Keep augers loaded to a maximum by forward speed of truck
   - f. Use cutter bar as a sight guide in deep snow
   - g. Listen for objects striking rotary
   - h. Watch for obstacles
   - i. Start at center and work toward shoulder
   - j. Drive with the flow of traffic
   - k. Keep as straight a line as possible
   - l. Drive five to seven mph, according to snow and road conditions
   - m. Cast snow stream with the wind if possible

ANSWERS TO TEST

n. Raise blower when operating close to shoulder

o. Raise blower unit to clear axles when traveling

p. To begin snow removal, lower rotary until full weight is on road surface

q. Bring up both truck and blower engines to proper operating temperature before using in sub-zero weather

r. Perform all required maintenance

s. Keep machine clean

8. a. Deep snow (snow drifted or higher than moldboard)

b. Hard, wind-driven snow

c. Heavy, wet snow

d. Banked snow

e. Freshly fallen snow

9. a. 3

b. 1

c. 6

d. 2

e. 4

f. 5

10. a, b, c, d, f, i

11. Evaluated to the satisfaction of the instructor

12. Performance skills evaluated to the satisfaction of the instructor

STRIPING AND PAINTING EQUIPMENT
UNIT XIV

UNIT OBJECTIVE

After completing this unit, the student should be able to safely and effectively operate striping and painting equipment. This knowledge will be shown by completing the assignment sheet, job sheets, and unit test with a minimum score of 85 percent.

SPECIFIC OBJECTIVES

After completing this unit, the student should be able to

1. Match terms associated with striping and painting equipment to their correct definitions.
2. Match types of road markings to their correct descriptions.
3. Match types of paint delivery systems to their correct descriptions.
4. Identify parts of a pump-pressure-system striping machine.
5. Match pump pressure operating systems to their correct descriptions.
6. Identify parts of a pressure-pot-system striping machine.
7. Match pressure pot operating systems to their correct descriptions.
8. Match controls on a typical striping machine to their correct functions.
9. Select from a list procedures for regulating pump pressure.
10. Identify parts of a typical spray gun nozzle.
11. Identify parts of a typical hand spray gun.
12. Match spray gun components to their correct functions.
13. State safety rules for operating a striping machine.
14. State procedures for effective striping machine operation.
15. Identify parts of a typical hand striping machine.
16. Match controls on a typical hand striping machine to their correct functions.
17. State procedures for safe and effective hand striping machine operation.
18. Identify control positions for road markings.

OBJECTIVE SHEET

19. Demonstrate the ability to

    a. Perform prestart inspection and maintenance procedures on a striping machine.

    b. Service a striping machine.

    c. Start, warm up, load paint, operate, and shut down a striping machine.

    d. Paint highway stripes.

    e. Perform prestart inspection and maintenance procedures on a hand striping machine.

    f. Start, warm up, operate, clean, and shut down a hand striping machine.

    g. Paint stripes on a parking lot using a hand striping machine.

STRIPING AND PAINTING EQUIPMENT
UNIT XIV

SUGGESTED ACTIVITIES

I. Suggested activities

A. Order slide/cassette tape programs to supplement unit.

1. *Roadway Markings and Markers, Part 1.* Color, 30 minutes, Traffic Technician Seminar, n.d. Available from Training Division, Oklahoma Department of Transportation, 200 N.E. 21, Oklahoma City, Oklahoma 73105, 405/521-4141.

(NOTE: This program discusses types of markings and markers and describes how they are used. It shows how signs and markings are used together to make roadways safer.)

2. *Roadway Markings and Markers, Part 2.* Color, 30 minutes, Traffic Technician Seminar, n.d. Available from Training Division, Oklahoma Department of Transportation, 200 N.E. 21, Oklahoma City, Oklahoma 73105, 405/521-4141.

(NOTE: This program describes various methods of installing pavement markings. It provides tips on how to get a good, clean-looking marking and demonstrates some of the problems in installing signs and markers.)

B. Make transparencies.

C. Provide students with objective sheet.

D. Provide students with information, assignment, and job sheets.

E. Discuss unit and specific objectives.

F. Discuss information and assignment sheets.

G. Demonstrate and discuss procedures outlined in job sheets.

H. Provide alternate jobs if those in job sheets are not practical.

I. Make a model or get from salvage a switch box control panel; let students practice switching as you call or show signals.

J. Stress that each machine is designed and built to departmental specifications and that equipment and controls may be different for each machine.

K. Limit study of this unit to equipment available to students.

L. Demonstrate or review compressor operation.

SUGGESTED ACTIVITIES

M. Review procedures for treating burns.

N. Arrange a field trip for students to watch striping machine and hand striping machine operations.

O. Provide each student with the opportunity to learn each job on the striper she/he is operating.

P. Give test.

II. Instructional materials

A. Objective sheet

B. Suggested activities

C. Information sheet

D. Transparency masters

1. TM #1--Roadway Markings: Two-lane, Two-way Roadway
2. TM #2--Roadway Markings: Multilane, Two-Way Roadway
3. TM #3--Typical Spray Systems: Pressure Pot, Heated Material
4. TM #4--Typical Spray Systems: Pressure Pot, Cold Material
5. TM #5--Typical Spray Systems: Siphon Feed and Airless Atomization
6. TM #6--Typical Switch Box Controls
7. TM #7--Parts of a Pressure Regulator

E. Assignment Sheet #1--Identify Control Positions for Road Markings

F. Answers to assignment sheet

G. Job sheets

1. Job Sheet #1--Perform Prestart Inspection and Maintenance Procedures on a Striping Machine
2. Job Sheet #2--Service a Striping Machine

SUGGESTED ACTIVITIES

3. Job Sheet #3--Start, Warm Up, Load Paint, Operate, and Shut Down a Striping Machine

4. Job Sheet #4--Paint Highway Stripes

5. Job Sheet #5--Perform Prestart Inspection and Maintenance Procedures on a Hand Striping Machine

6. Job Sheet #6--Start, Warm Up, Operate, Clean, and Shut Down a Hand Striping Machine

7. Job Sheet #7--Paint Stripes on a Parking Lot Using a Hand Striping Machine

H. Test

I. Answers to test

III. Unit references

A. *Air Spray Manual.* Franklin Park, Illinois: Binks Manufacturing Company, 1976.

B. *Compressed Air Spray Gun Principles.* Franklin Park, Illinois: Binks Manufacturing Company, 1981.

C. *Highway Striping Training Manual.* Parsippany, New Jersey: Prismo Universal Corporation, n.d.

D. *Manual on Uniform Traffic Control Devices for Streets and Highways.* Washington, D.C.: U.S. Department of Transportation, Federal Highway Administration, 1978.

E. *Model 21 Automatic Spray Gun, Part Sheet 1143R-13.* Franklin Park, Illinois: Binks Manufacturing Company, 1980.

F. *Spray Application Processes.* Binks Training Division, TD 49-2R. Franklin Park, Illinois: Binks Manufacturing Company, 1981.

STRIPING AND PAINTING EQUIPMENT
UNIT XIV

INFORMATION SHEET

I. Terms and definitions

A. Striping machine--Truck-mounted spray equipment; used to stripe road surfaces (Figure 1)

(NOTE: The striping machine can paint up to three stripes at a time on each side. Several paint delivery systems are used. Figure 1 shows a pressure pot system; Figure 2 shows a pump pressure system.)

EXAMPLES:

FIGURE 1

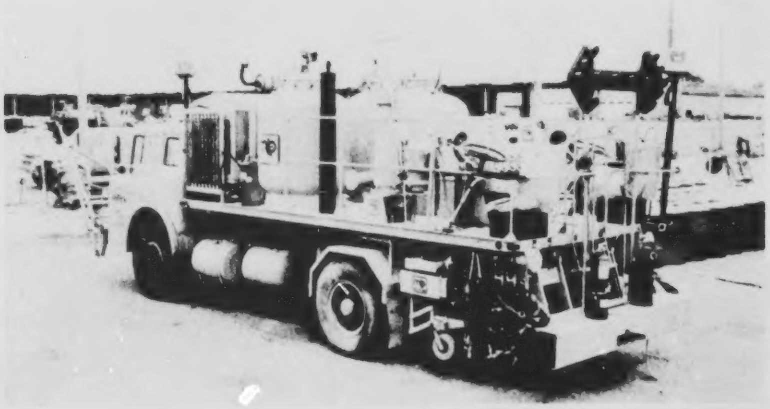
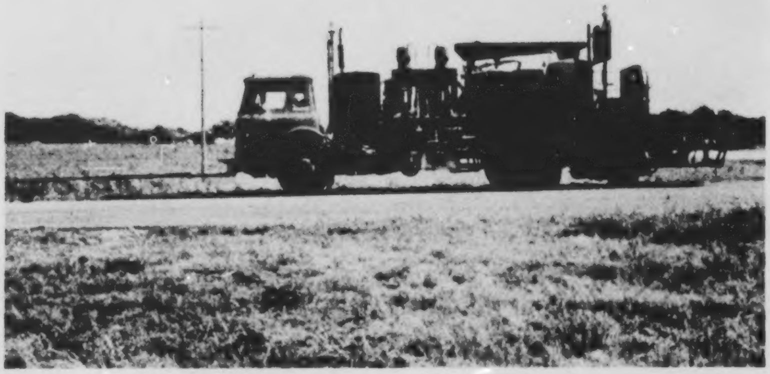


FIGURE 2

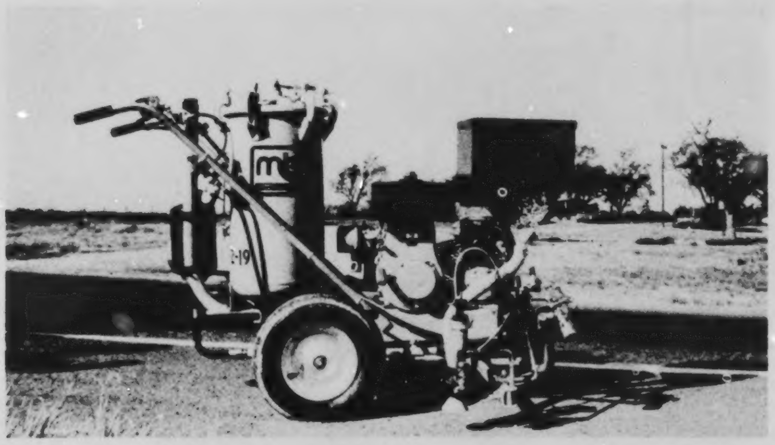


INFORMATION SHEET

B. Hand striping machine--Small spray paint unit; used to paint curbs and stripe small areas (Figure 3)

EXAMPLES: Parking lots, hash marks, gores

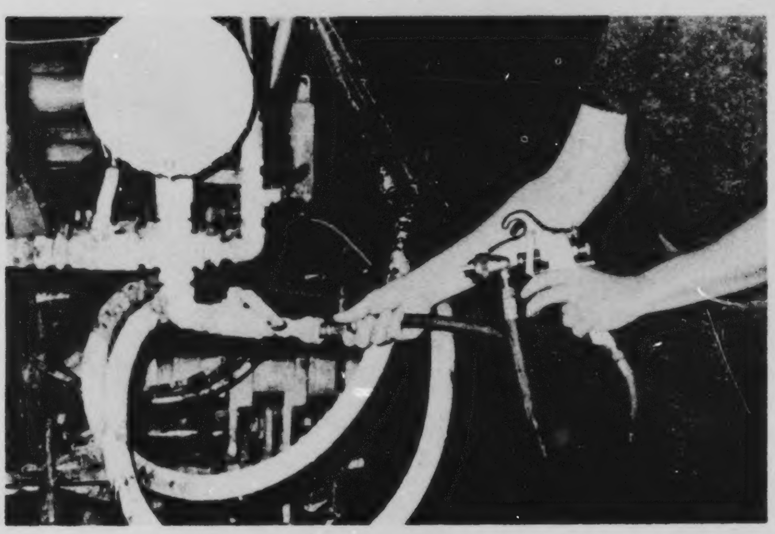
FIGURE 3



C. Hand spray gun--Attachment for striping machine or hand striping machine, or a separate unit with its own paint source; used to paint curbs or stripe small areas (Figure 4)

EXAMPLE:

FIGURE 4

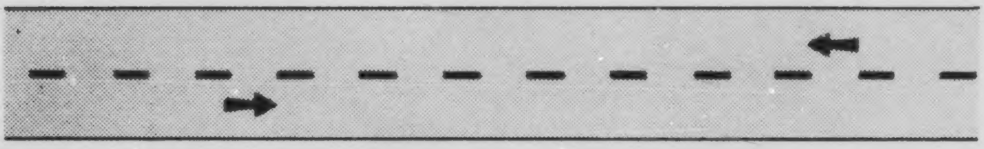


INFORMATION SHEET

D. Skip line--Broken center line (Figure 5)

EXAMPLE:

FIGURE 5



E. Dash--Painted part of a skip line

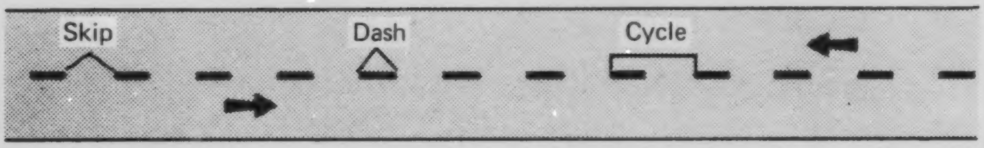
F. Skip--Unpainted part of a skip line

G. Cycle--Dash-skip pattern beginning at start of one dash and ending at start of next dash (Figure 6)

(NOTE: Cycles vary according to use and state policy.)

EXAMPLE: 12' dash, 33' skip = 45' cycle
12' 6" dash, 37' 6" skip = 50' cycle

FIGURE 6



H. Two-lane center line--Yellow dashed or solid line indicating passing and no-passing zones on two-lane, two-way roadways

I. Multilane roadway lane lines--Dashed white lines separating traffic traveling in the same direction

J. Edge line--Solid stripe along outside of traffic lane

(NOTE: A solid white line indicates no traffic or no opposing traffic. A solid yellow line indicates opposing traffic on the other side of the yellow line.)

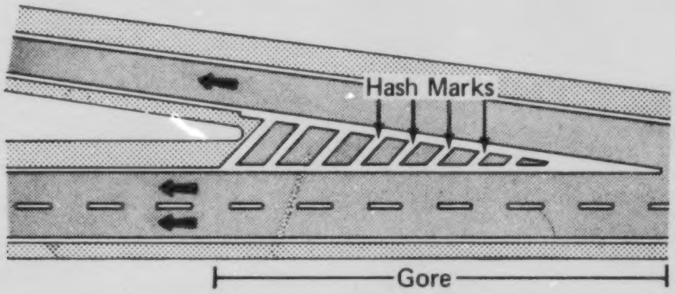
K. Hash mark--Mark identifying areas such as islands and gores, where traffic is prohibited (See Figure 7.)

INFORMATION SHEET

L. Gore--Line which guides approaching traffic around obstacles; also marks departures, such as exit ramps, from the main roadway; usually V-shaped (Figure 7)

EXAMPLES: Islands where multilane roadway begins or ends, places where highway signs or light fixtures are mounted

FIGURE 7



Exit Ramp

M. Glass beads--Glass spheres embedded in the paint to reflect light

N. Atomize--To reduce to a fine spray by the tearing action of air

O. Internal atomization--Paint atomized inside spray gun

P. External atomization--Paint atomized as it shoots out of gun

Q. Regulator--Device that maintains pressure at a preset level

R. Separator--Device that removes condensed water and oil from air lines

S. Shroud--Cover or guard which focuses spray pattern and makes a clean edge

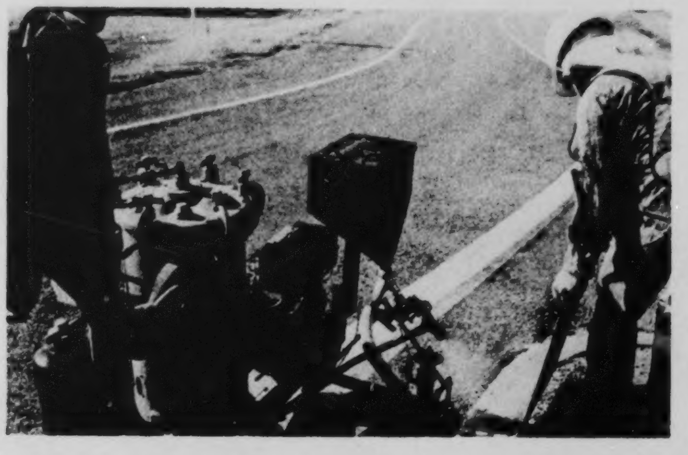
T. Agitator--Device for stirring paint to keep it from separating

INFORMATION SHEET

U. Masking--Object that keeps paint off surfaces next to those being painted (Figure 8)

EXAMPLES: Signs or "tins" used to protect sidewalk where curb is to be painted

FIGURE 8



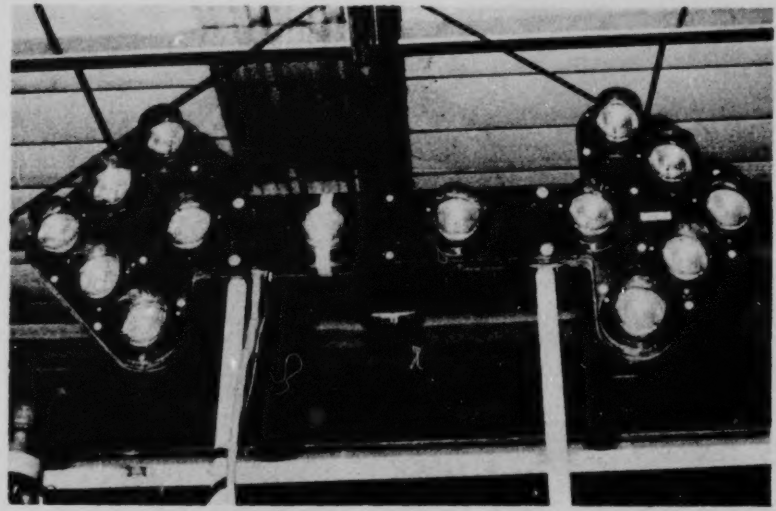
V. Pressure feed--Air or pump pressure forcing material through lines

W. Gravity feed--Material flowing downward toward lowest point

X. Arrow board--Flashing lights that direct traffic flow (Figure 9)

EXAMPLE:

FIGURE 9

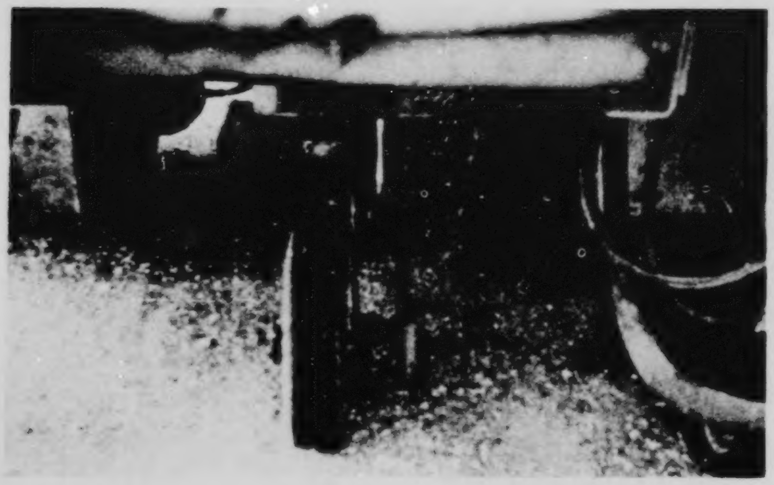


INFORMATION SHEET

Y. Timing wheel--Device that sends electrical impulses to set cycle and measure number of feet painted (Figure 10)

EXAMPLE:

FIGURE 10



Z. Solid-state timer--Computerized device for operating paint and bead guns in cycle

II. Types of road markings and their descriptions (Transparencies #1 and #2; Assignment Sheet #1; Job Sheets #4 and #7)

(NOTE: Each machine will use guns according to departmental policy. The operator must switch guns to SKIP, SOLID, or OFF position according to marked zones.)

A. Yellow dash-skip cycles--Skip center line for two-lane roadway

B. White dash-skip cycles--Lane line for multilane roadway

C. Solid yellow line to driver's left--Center line for no passing in driver's lane

D. Two solid yellow lines--Center line for no passing in both lanes

E. Solid white line on right-hand edge--Edge line for two-lane, two-way roadway

F. Solid yellow line on left-hand edge; solid white line on right-hand edge--Edge lines for multilane roadway

INFORMATION SHEET

III. Types of paint delivery systems (Transparencies #3-#5)

(NOTE: Systems may use cold or heated paint and may have external or internal atomization. All systems include a filtering process.)

A. Pressure pot--Material is moved by air pressure from pressurized tanks to guns

(NOTE: Paint, solvent, and bead tanks are pressurized.)

B. Pump-pressure feed--Material is pumped from unpressurized barrels or tanks to guns

(NOTE: Bead tank may be pressurized to keep beads dry and flow constant.)

C. Zero-pressure feed--Material is gravity-fed to a diaphragm or gear pump and then pumped under pressure to guns

D. Siphon feed--Material is drawn by suction from holding tank to gun

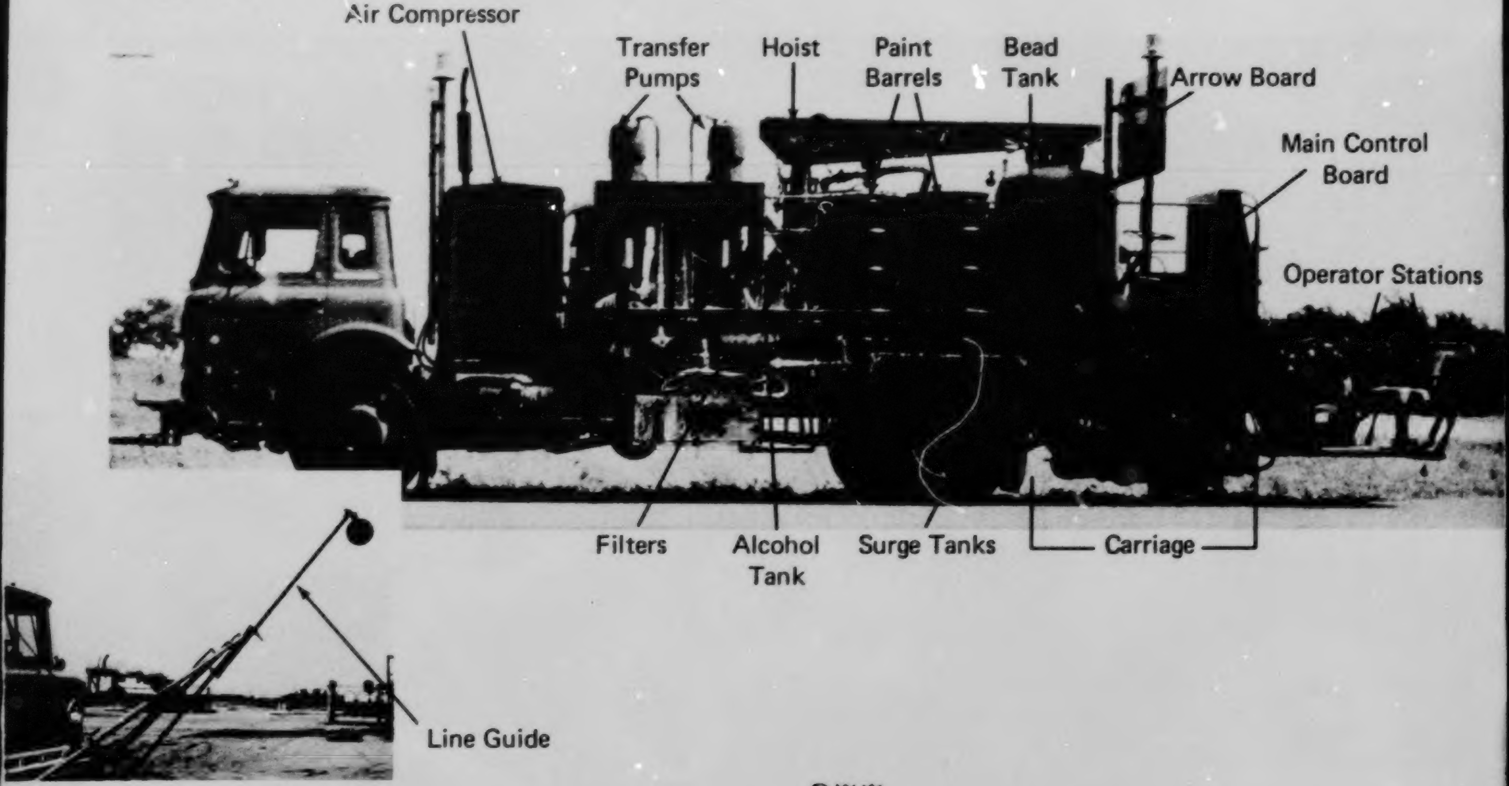
E. Airless atomization--Material is pumped from an unpressurized tank, agitated, fed to high pressure pumps, and sprayed under extreme pressure

(CAUTION: An airless system delivers paint at 1200 psi to 1800 psi. The pressure atomizes the paint. The airless system may be hazardous and requires additional caution in its use.)

IV. Parts of a pump-pressure-system striping machine (Figure 11; Job Sheet #2)

(NOTE: Barrels of paint are hoisted onto the truck from a flatbed truck. Paint is pumped directly from barrels to filters surge tanks, and guns. Equipment will vary with manufacturer and model.)

FIGURE 11


Air Compressor
Transfer Pumps
Hoist
Paint Barrels
Bead Tank
Arrow Board
Main Control Board
Operator Stations
Filters
Alcohol Tank
Surge Tanks
Carriage
Line Guide

INFORMATION SHEET

V. Pump pressure operating systems

A. White paint system--Transfer pump moves paint from barrels through filter to surge tank and then to right gun; has crossover line to left

B. Yellow paint system--Transfer pump moves paint from barrels through filter to surge tank and then to left gun; has crossover line to right

C. Air system--Compressed air operates pumps, carriages, and timing wheel

D. Solvent system--Pump on barrel or tank moves solvent to guns for cleaning lines and nozzles

E. Alcohol system--Pump moves material into air lines between filter and guns to keep out condensation in cold weather

(NOTE: Alcohol is recirculated back to holding tank after use.)

F. Surge tank--Collects supply of paint for delivery to guns; keeps pressure constant at nozzles

(NOTE: Without a surge-tank system, the paint flow would surge and slow with the piston action of the pump.)

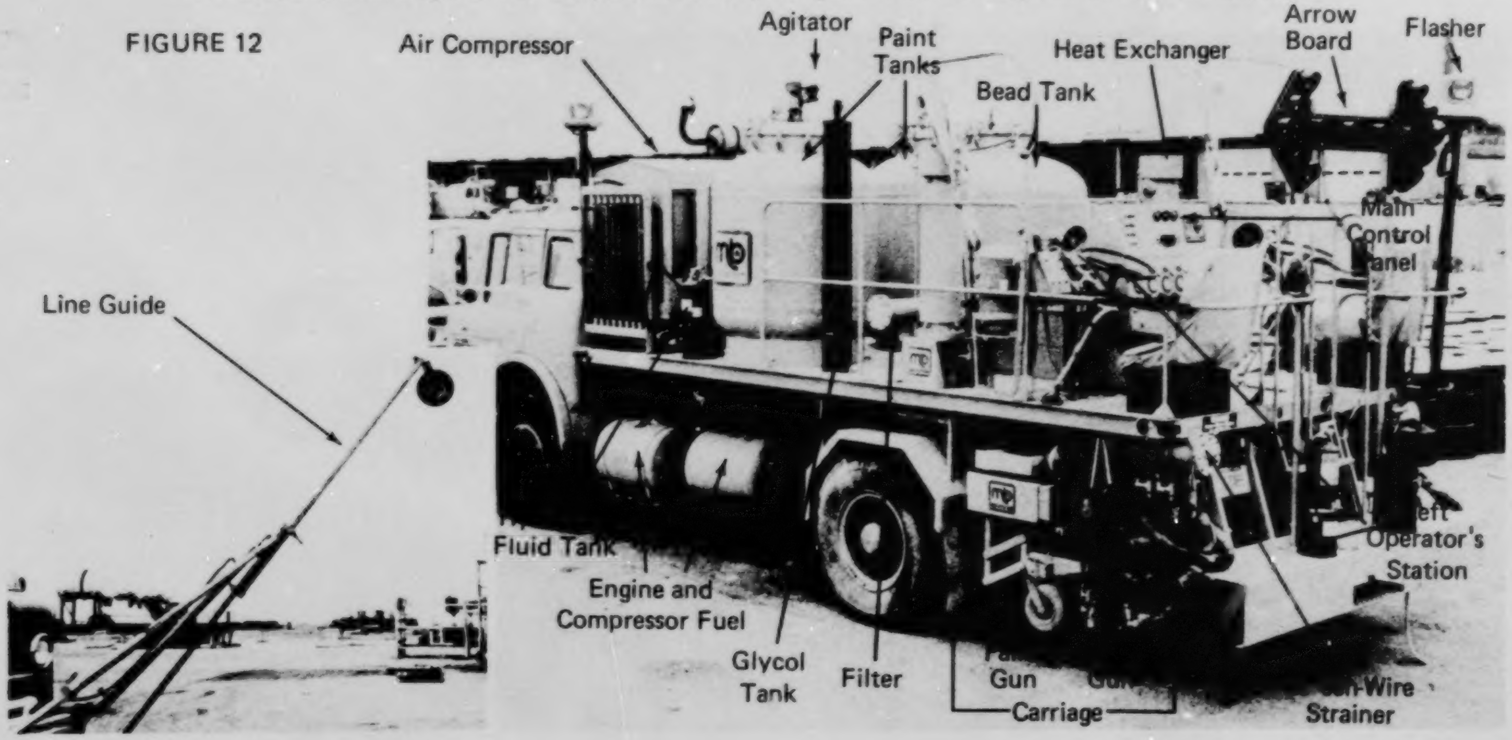
VI. Parts of a pressure-pot-system striping machine (Figures 12 and 13; Job Sheet #2)

(NOTE: Equipment will vary with manufacturer and model.)

A. Left side

(NOTE: Paint is pumped into pressurized tanks. It flows through filters to heat exchangers, then through screen-wire strainers, and then to guns. The left side has three paint guns on the carriage for center-line striping.)

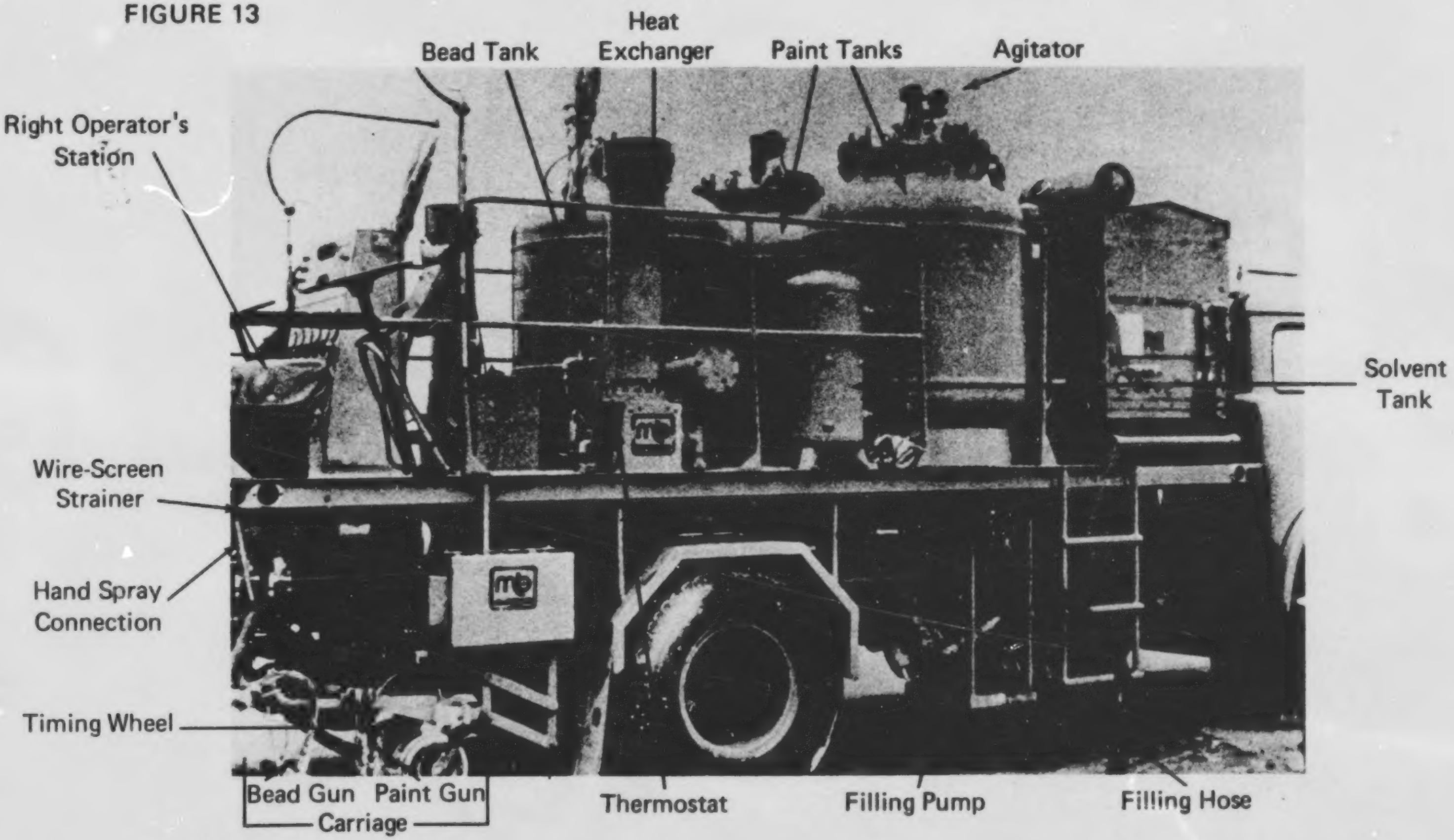
FIGURE 12


Air Compressor
Agitator
Paint Tanks
Bead Tank
Heat Exchanger
Arrow Board
Flasher
Main Control Panel
Line Guide
Fluid Tank
Engine and Compressor Fuel
Glycol Tank
Filter
Gun
Carriage
eft Operator's Station
-Wire Strainer

B. Right side

(NOTE: The right side usually has one or two paint guns on the carriage for painting the edge line.)

FIGURE 13


Heat Exchanger
Bead Tank
Paint Tanks
Agitator
Right Operator's Station
Solvent Tank
Wire-Screen Strainer
Hand Spray Connection
Timing Wheel
Bead Gun
Paint Gun
Carriage
Thermostat
Filling Pump
Filling Hose

INFORMATION SHEET

VII. Pressure pot operating systems and descriptions

(NOTE: Each system has a main valve and a set of line valves.)

A. White paint system--Usually located on right side of truck with a crossover to the left; material under pressure flows from tank through filters, heat exchanger, screen strainer, and then to guns

B. Yellow paint system--Usually located on left side of truck with a crossover to the right; material under pressure flows from tank through filters, heat exchanger, screen strainer, and then to guns

C. Glass bead system--Pressure forces material from tank to guns

D. Air system--Compressed air flows from compressor to pressure tanks, regulators, and nozzles

(NOTE: Application of air system will vary with each machine. Generally, air pressurizes the paint, bead, and solvent tanks, atomizes paint at the nozzle, keeps the timing wheel on the ground, and operates the agitator motors.)

E. Solvent system--Material flows from tank through lines to nozzles; can be directed through individual atomizing air lines to nozzles as needed

F. Heat exchange system--Glycol is heated and circulated through exchanger; paint line runs through exchanger and absorbs heat

(NOTE: The exchanger operates like a radiator. Glycol may be heated by a diesel-fired heater, or through the radiator and exhaust system, or by some other method. A circulating pump moves the heated solution through the exchangers. Heating fins absorb and hold the heat so that when the paint line passes through the exchanger, heat is transferred to the paint. There is an exchanger for white paint and one for yellow paint.)

G. Hydraulic system--Operates pump, carriages, and guide assembly

(NOTE: The hydraulic system will vary with each machine.)

INFORMATION SHEET

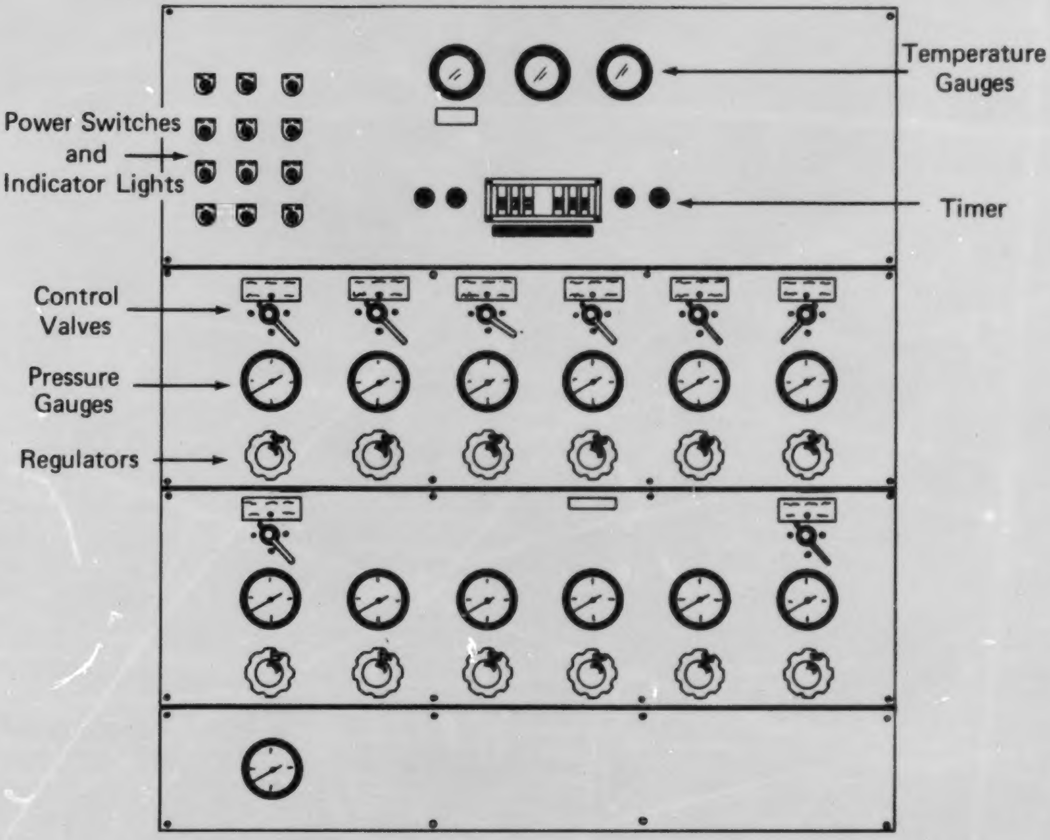
VIII. Controls and their functions on a typical striping machine (Job Sheet #3)

(NOTE: Controls will vary with each machine. Pressure pot controls are shown below. Pump-pressure-system controls are basically the same, except that they do not have control valves for guns; they have pressure regulators only. A unit with a diesel-fired furnace will also have heater controls on the control panel. Some units have individual bead-gun pressure regulators.)

A. Main control board (Figure 14)

EXAMPLE:

FIGURE 14


Power Switches and Indicator Lights
Temperature Gauges
Timer
Control Valves
Pressure Gauges
Regulators

1. Power switches and indicator lights--ON-OFF controls for main power, cab power, heat exchangers, circulating pump, flasher and beacon

   (NOTE: Green lights indicate that power is on; red lights indicate that material has reached operating temperature.)

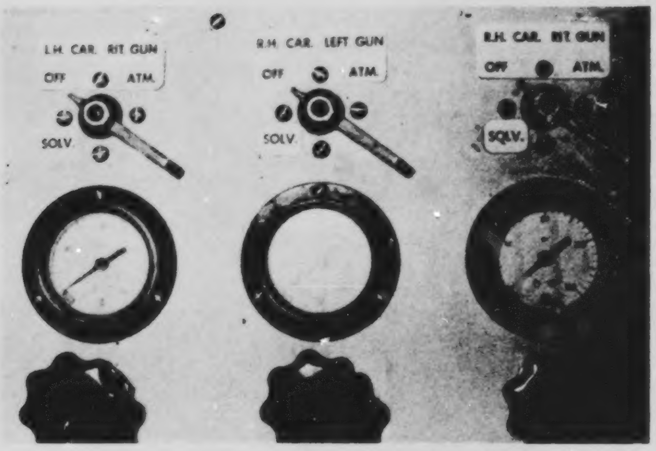
INFORMATION SHEET

2. Control valves--ON-OFF control for guns, and RAISE-LOWER control for carriages (Figure 15)

   (NOTE: *Atomizing* means that guns are spraying. Solvent position blows nozzles clean.)

   EXAMPLE:

FIGURE 15


L.H. CAR. RIT GUN
OFF
ATM.
SOLV.
R.H. CAR. LEFT GUN
OFF
ATM.
SOLV.
R.H. CAR. RT GUN
OFF
ATM.
SOLV.

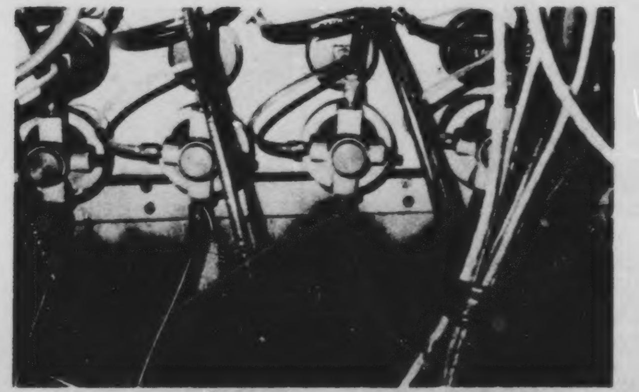
3. Pressure gauges--Register pressure in each system

4. Regulators--Set operating pressure (Figure 16; Transparency #7)

   (NOTE: Regulators control pressure for each gun, for the timing wheel, carriage controls, bead tank, solvent tank, and paint tanks. On a pump-pressure system, the regulators set pump and bead pressure only.)

   EXAMPLE:

FIGURE 16



INFORMATION SHEET

5. Temperature gauges--Register temperature of glycol and yellow and white paint tanks

6. Timer--Sets dash and cycle length

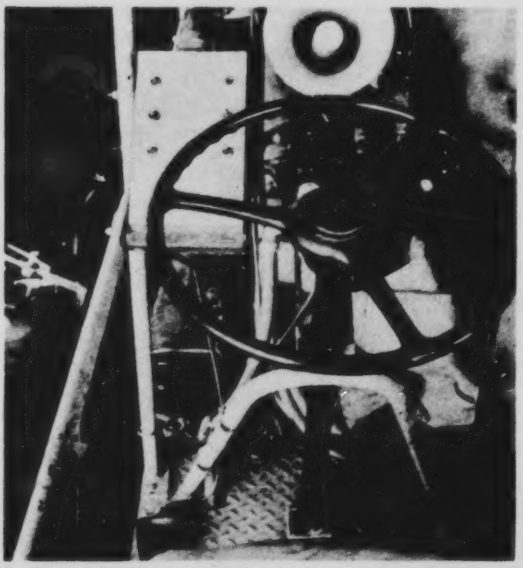
   (NOTE: The timer operates from movement of the timing wheel.)

B. Switch box controls (Figure 17; Transparency #6)

(NOTE: Control boxes are mounted on the left and right sides of the truck. They control the guns for those sides. On some models, all guns can be operated from a master-control switch box on the left side.)

EXAMPLE:

FIGURE 17



1. Master switch--Turns on power

2. Zero light--Indicates beginning of a cycle

3. Mark-preset switch--Activates timing system

   (NOTE: Timing system includes electric impulses from timing wheel to paint guns, bead guns, and footmeter. In preset position, timing system is turned off.)

4. Advance-retard switch--Increases or decreases length of skip

   (NOTE: The advance-retard switch allows the operator to match the dashes to existing dash pattern.)

INFORMATION SHEET

5. Gun function switches--Activate solid line, skip line, or shut-down for each gun

(NOTE: Bead guns operate in the same sequence as the paint guns. Bead flow starts shortly before the paint flow because beads take longer to reach the guns.)

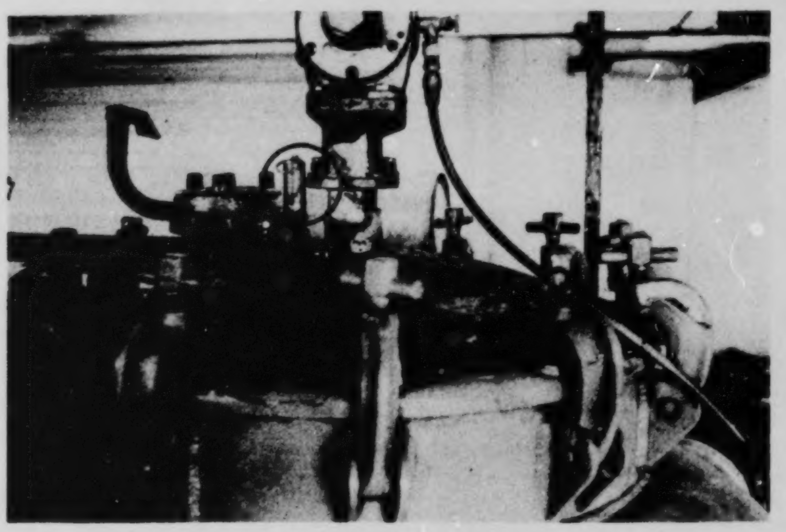
C. Other controls

1. Pressure relief valves--Release excess pressure from tanks and lines (Figure 18)

(NOTE: Valves are located on each pressurized tank and in several other places in the system, depending on the equipment. Adjust pressure often during operation, and bleed lines and tanks before opening.)

EXAMPLE:

FIGURE 18



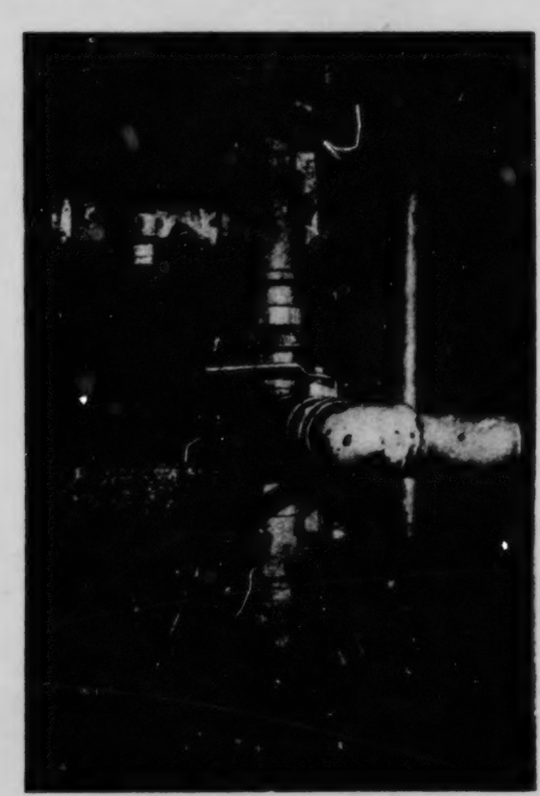
INFORMATION SHEET

2. Flow valves--Control the flow of air and material; located on all lines (Figure 19)

   (NOTE: Valves should be color coded to identify yellow paint, white paint, and solvent lines. The location of valves will vary with each machine. Learn the system for the machine you are using before operating it.)

   EXAMPLE:

FIGURE 19

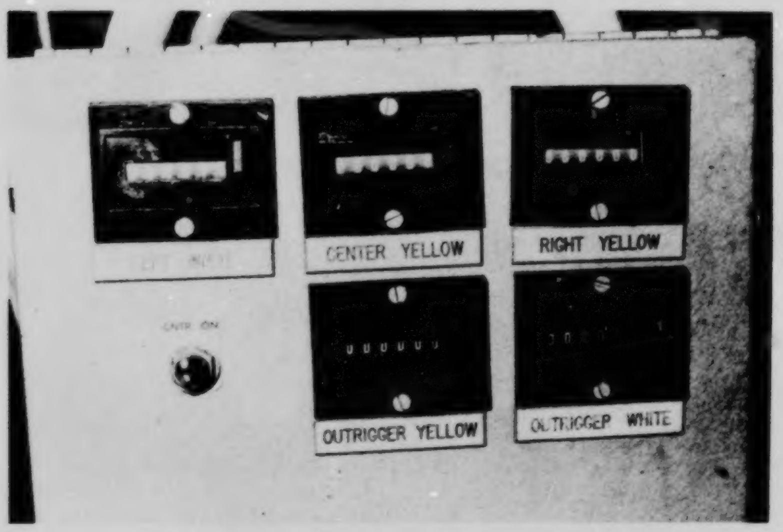


INFORMATION SHEET

3. Footmeter--Indicates number of feet of road surface painted by each gun (Figure 20)

   EXAMPLE:

FIGURE 20


CENTER YELLOW
RIGHT YELLOW
OUTRIGGER YELLOW
OUTRIGGER WHITE

4. Steering wheel--Moves carriage in or out to place paint line

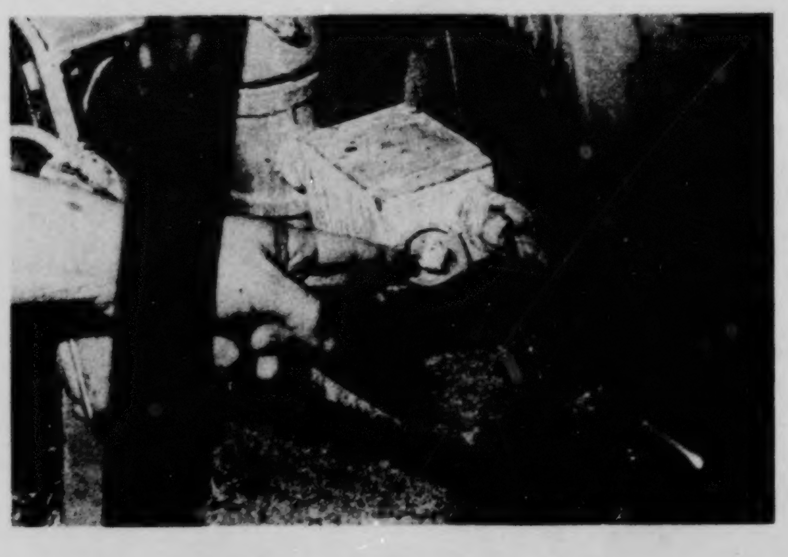
   (NOTE: Carriage moves in direction of wheel. With practice, the operator can keep the center line or edge line perfectly matched with existing lines or with the contour of the edge.)

INFORMATION SHEET

5. Heat exchanger control--Sets temperature (on heated-paint equipment only) (Figure 21)

   EXAMPLE:

FIGURE 21



INFORMATION SHEET

IX. Procedures for regulating pump pressure

A. Use higher pressure in the morning, and decrease pressure as cold paint warms up

B. Adjust pressure as needed for different road surfaces

EXAMPLE: A chip-seal surface is rougher and more absorbent than an asphalt mat and will use more paint applied at higher pressure.

C. Keep pressure adjusted so that paint is even and edges are clean

D. Increase pressure to gun if paint is thin or spotty

E. Decrease pressure if paint splatters

F. Adjust bead pressure as needed

EXAMPLE: With too little pressure, beads won't go to the edges of the line; with too much pressure, beads will knock the paint out and pour out over the edges.

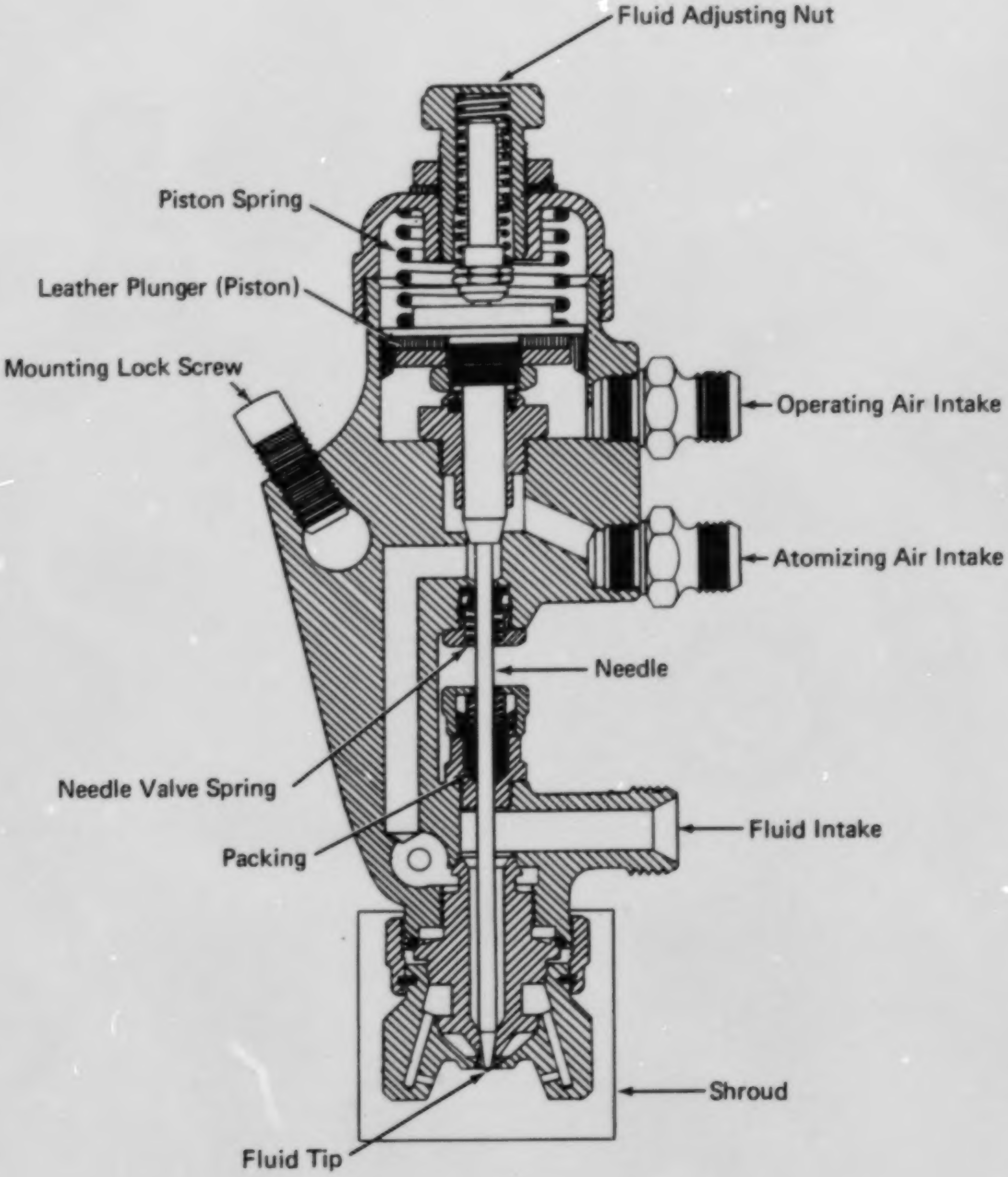
G. Replace diaphragm and clean needle valve as needed

H. Lower pressure by adjusting regulator and relieving pressure at relief valves

INFORMATION SHEET

X. Parts of a typical spray gun nozzle (Figure 22)

FIGURE 22

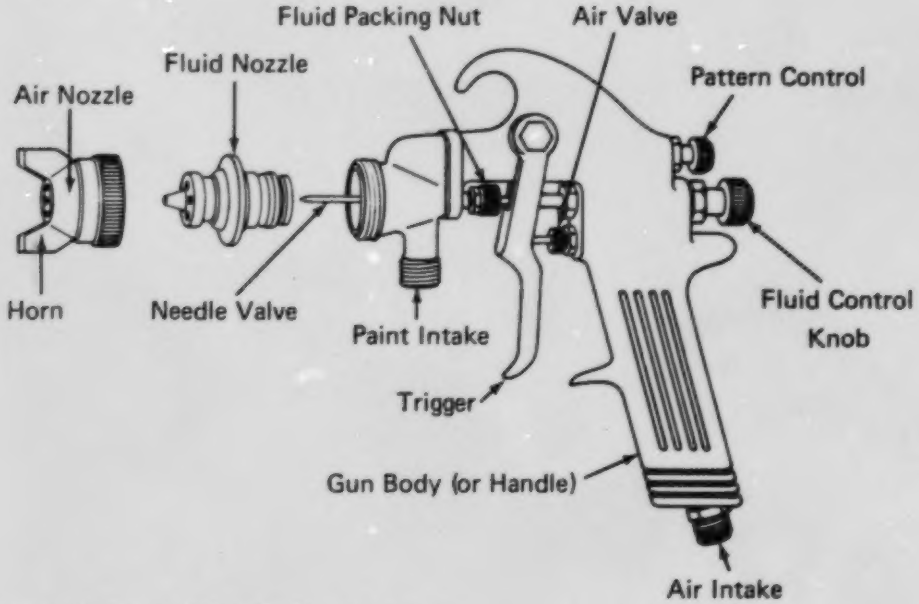

Fluid Adjusting Nut
Piston Spring
Leather Plunger (Piston)
Mounting Lock Screw
Operating Air Intake
Atomizing Air Intake
Needle
Needle Valve Spring
Fluid Intake
Packing
Shroud
Fluid Tip

Adapted with permission of Binks Manufacturing Company.

INFORMATION SHEET

XI. Parts of a typical hand spray gun (Figure 23)

FIGURE 23


Fluid Packing Nut
Air Valve
Fluid Nozzle
Pattern Control
Air Nozzle
Horn
Needle Valve
Paint Intake
Fluid Control Knob
Trigger
Gun Body (or Handle)
Air Intake

Used with permission of Binks Manufacturing Company.

XII. Spray gun components and their functions (Job Sheets #3 and #6)

(NOTE: The following functions apply generally to spray guns on the striping machine, on the hand striping machine, and on the hand spray gun.)

A. Air nozzle--Directs compressed air through horn holes into paint stream, atomizing paint and forming spray pattern

B. Fluid nozzle--Meters and directs paint into air stream; also forms seat for fluid needle to shut off flow

C. Needle--Shuts off flow through fluid nozzle

D. Trigger--Operates air valve and fluid needle

E. Air valve--Controls air flow through gun

(NOTE: The air valve is operated directly by the trigger. When the trigger is released, a spring returns the air valve to the closed position, stopping air flow. The fluid needle returns to the closed position before the air valve shuts off air flow.)

F. Pattern control--Adjusts size of fluid-nozzle opening

G. Fluid control--Adjusts fluid volume (used with siphon feed only)

INFORMATION SHEET

XIII. Safety rules for operating a striping machine (Job Sheets #3 and #4)

(NOTE: On the striping machine, you must be concerned with the public's safety as well as your own.)

A. Read operator's manual thoroughly: know your machine

B. Study departmental safety manual

C. Wear a respirator when hand spraying

D. Wear a visible vest when hand spraying

E. Do not smoke while loading paint or flushing machine

F. Relieve pressure before opening any pressurized tank or coupling

G. Avoid contact with solvent

(CAUTION: Follow cautions on solvent container.)

H. Thoroughly clean solvent from skin as quickly as possible

I. Keep machine clean

XIV. Procedures for effective striping machine operation (Job Sheet #1)

(NOTE: A striping operation is a team effort. There will usually be two striper operators, one on each carriage; the truck operator, the patrol escort operator, the supply truck operator, and the supervisor. The striper is equipped with an intercom at each operator's station. Keep alert to signals from the truck operator and from other operators on the striping machine.)

A. Perform all prestart inspection and maintenance procedures

B. Set pressures according to manufacturer's recommendations

C. Know all controls and their functions

D. Keep alert; watch for changes in skip and solid lines and for off lines

EXAMPLES: Edge line goes off at intersections, driveways; center line goes to skip and solid in no-passing zones

E. Know signals and keep in contact with other crew members

EXAMPLE: Advise driver if truck is moving too fast or too slow for good coverage.

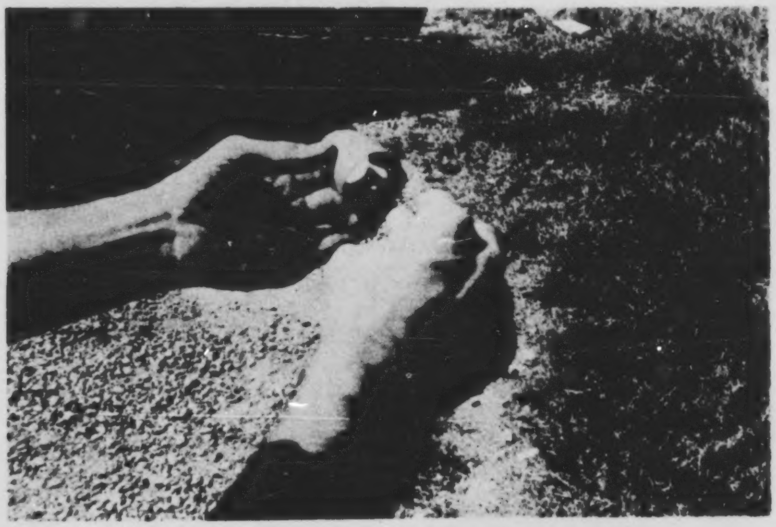
INFORMATION SHEET

F. Clean shrouds often (Figure 24)

(NOTE: Scrape the inside with a knife so that paint will not build up and leave ragged edges on the stripes.)

EXAMPLE:

FIGURE 24



G. Keep beads dry

H. Adjust nozzle height and angle as needed

EXAMPLES: Nozzle height adjusts width of line; nozzle is angled for painting curbs.

I. Make changes *gradually*

EXAMPLES: Narrowing road, changing from four lanes to two lanes

J. Paint new lines on top of existing lines

(NOTE: Use advance-retard switch to match center line cycle. Keep edge lines aligned with existing stripes.)

K. Operate advance-retard switch with short jogs until cycles match

(NOTE: Change pattern gradually; it may take several skips to match existing cycle.)

L. Empty extractors often

INFORMATION SHEET

M. Use traffic control devices as needed

(NOTE: Heated paint dries in one minute or less; cold paint may take as long as fifteen minutes to dry.)

EXAMPLES: Forward and rear signal trucks for heated and cold paint; cones placed at intersections and every half mile for cold paint

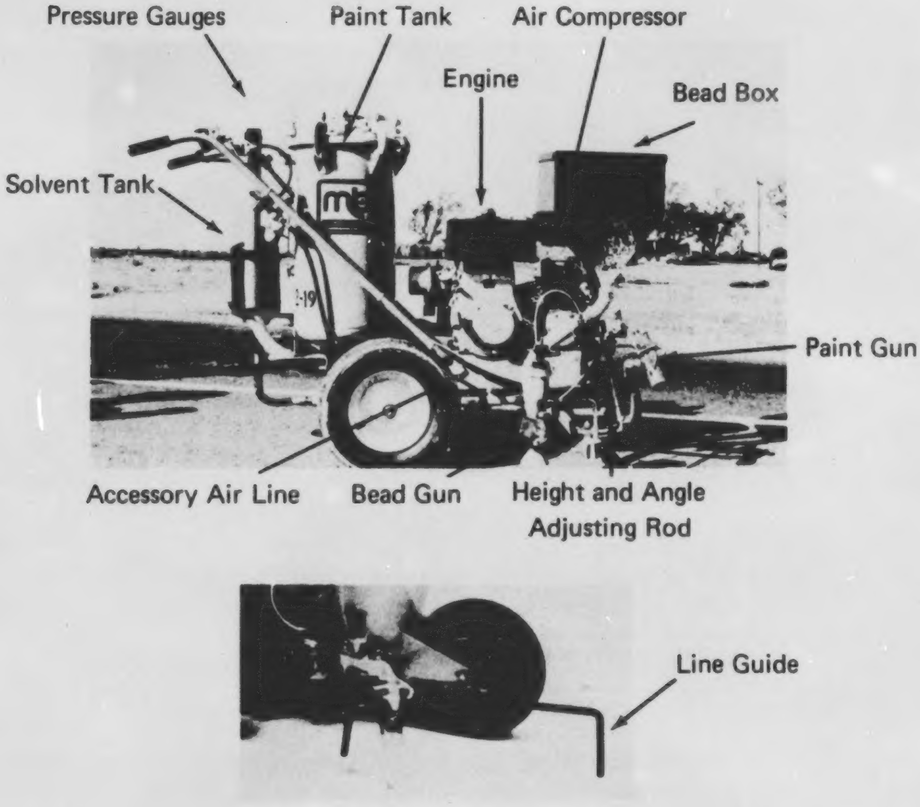
N. Clean nozzles as needed for even flow of paint

(NOTE: If unit is equipped with bleeder guns and atomized solvent, flush tips frequently or as needed. If unit is not so equipped, stop truck and blow out nozzles with solvent.)

O. Blow out lines and fill with solvent before storing machine

XV. Parts of a typical hand striping machine (Figure 25; Job Sheets #5-#7)

FIGURE 25


Pressure Gauges
Paint Tank
Air Compressor
Engine
Bead Box
Solvent Tank
Paint Gun
Accessory Air Line
Bead Gun
Height and Angle Adjusting Rod
Line Guide

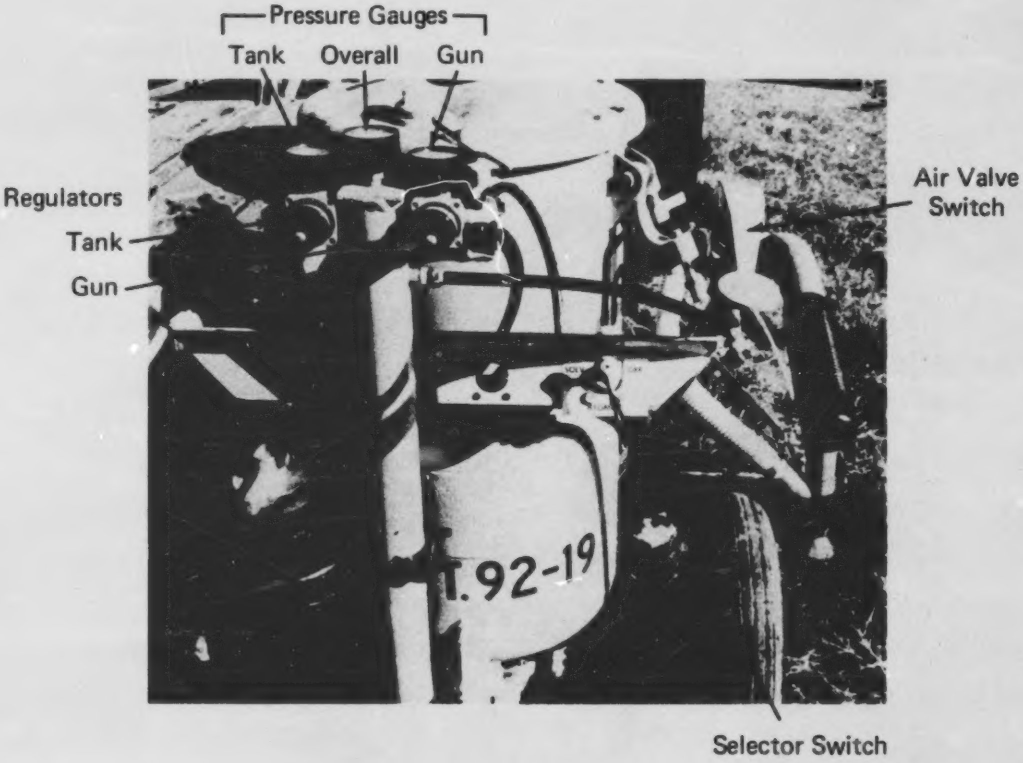
INFORMATION SHEET

XVI. Controls and their functions on a typical hand striping machine (Figure 26; Job Sheets #6 and #7)

(NOTE: Controls will vary with manufacturer and model.)

EXAMPLE:

FIGURE 26
HAND STRIPING MACHINE CONTROLS


Pressure Gauges
Tank
Overall
Gun
Regulators
Tank
Gun
Air Valve Switch
T.92-19
Selector Switch

A. Pressure gauges--Register air pressure in paint tank, in overall system, and at paint gun

B. Regulators--Set pressure at tank and gun

C. Selector switch--Opens and closes paint or solvent lines

(NOTE: Hose must be switched from paint tank to solvent tank to run solvent. OFF position shuts off lines; engine still runs.)

INFORMATION SHEET

D. Air valve switch--Sends air to gun to atomize paint and operate bead dispenser

(NOTE: Bead dispenser is gravity fed. When air goes to the gun, it opens the dispenser. Feed line is turned off when the paint gun is adjusted at an angle.)

E. Throttle (not shown)--Sets engine speed

XVII. Procedures for safe and effective hand striping machine operation (Job Sheet #7)

A. Wear hard hat and visible vest

B. Use required traffic control devices

C. Perform all prestart inspection and maintenance procedures

D. Be sure paint tank is clean before adding paint

E. Use a filter screen when pouring paint into tank

(NOTE: Flush screen with solvent after use.)

F. Adjust nozzle height and angle according to job

EXAMPLES: Paint islands and curbs at an angle; aim nozzle straight down for hash marks and stripes; set height according to desired width of stripe.

G. Be sure you know your starting and stopping point before painting

H. Signal crew before starting

I. Line up machine for a straight approach

(NOTE: You cannot change or adjust the route once you start.)

J. Move at a constant speed

K. Keep lines straight

L. Keep gun as close to curb as possible when painting islands or curbs

M. Do not run wheels over new paint when turning or lining up for next pass

N. Flush lines and nozzles with solvent several times during the day

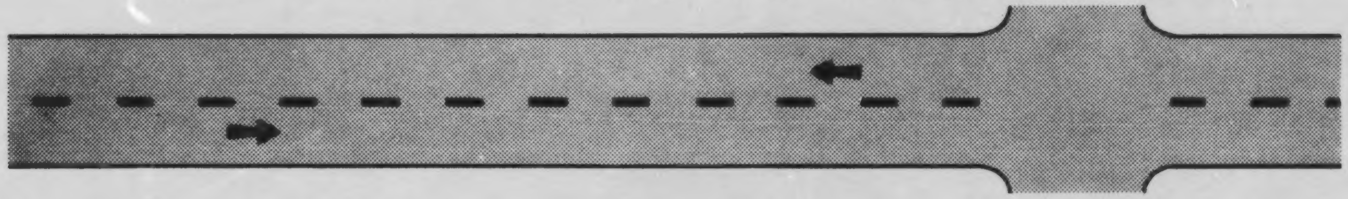
O. Soak nozzle and shroud in solvent when not in use

P. Make needed adjustments over painted area

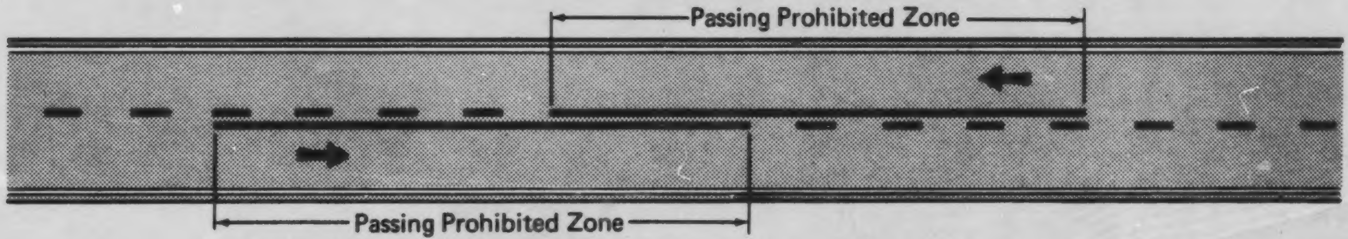
(NOTE: Paint may spill or leak; be sure machine is over an area already painted and not on a clean road surface.)

Roadway Markings: Two-lane, Two-way Roadway

Typical Two-lane, Two-way Marking With Passing Permitted



Typical Two-lane, Two-way Marking With Passing Prohibited Zones


Passing Prohibited Zone
Passing Prohibited Zone

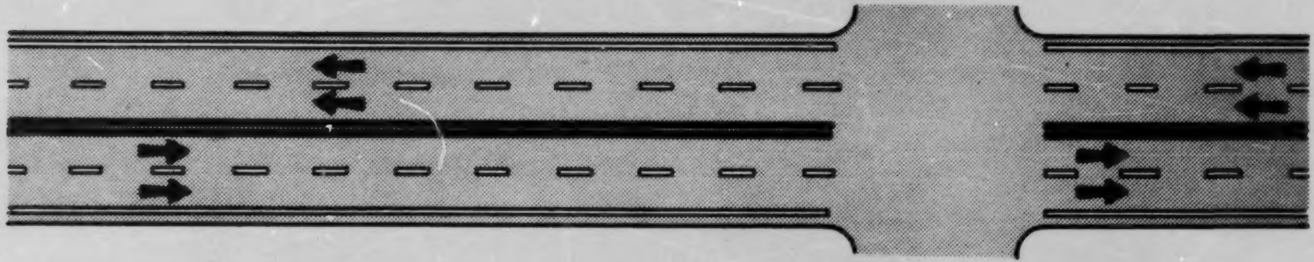
Legend: Yellow Lines ━━━ ▬ ▬ ▬ ▬ ▬
White Lines ═══ ▭ ▭ ▭ ▭ ▭

TM #1

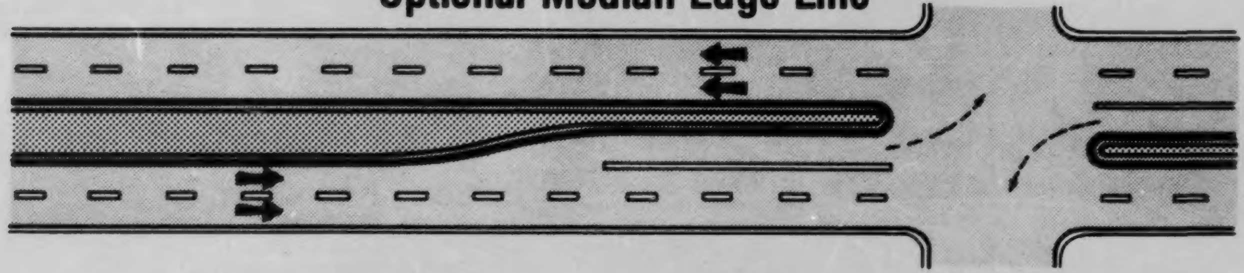
DOT II - 743

Roadway Markings: Multilane, Two-way Roadway

Typical Multilane, Two-way Marking

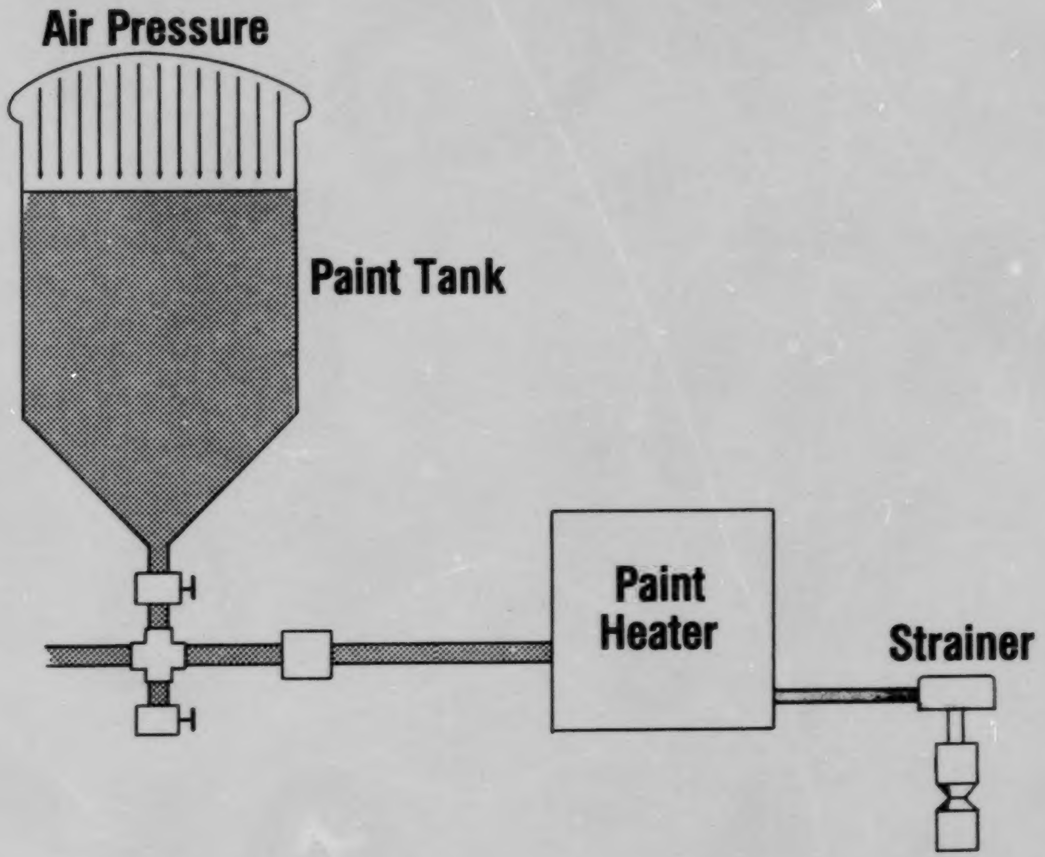


Typical Divided Highway Marking With Raised Median and Optional Median Edge Line



Legend: Yellow Lines ━━━ ▬ ▬ ▬ ▬ ▬
White Lines ═══ ▭ ▭ ▭ ▭ ▭

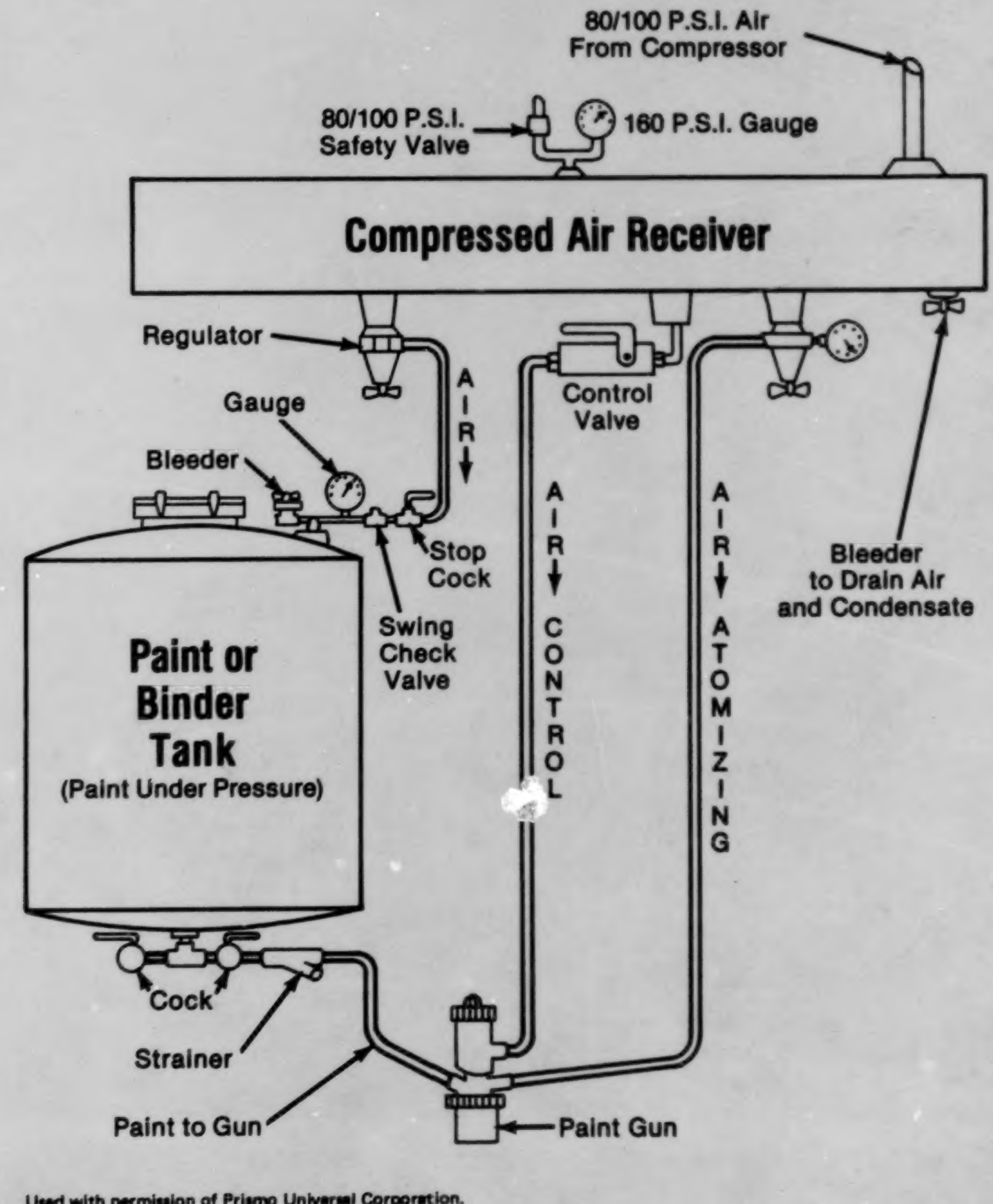
Typical Spray Systems: Pressure Pot, Heated Material


Air Pressure
Paint Tank
Paint Heater
Strainer

TM #3

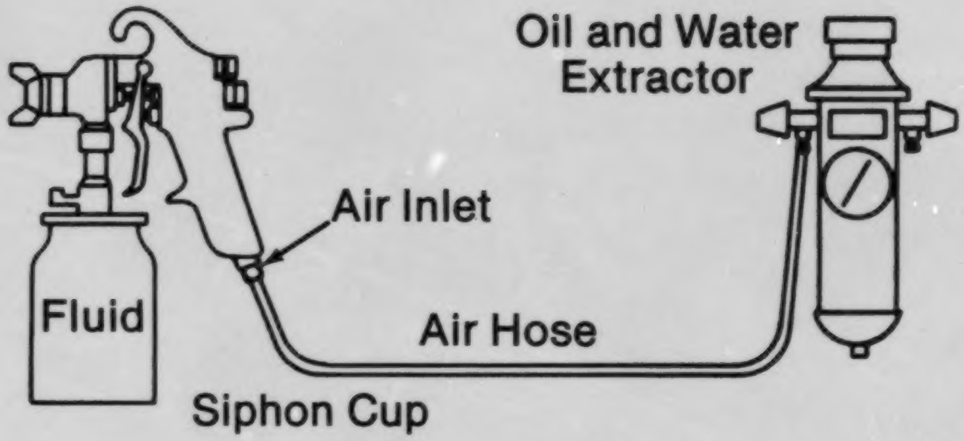
DOT II-747

Typical Spray Systems: Pressure Pot, Cold Material

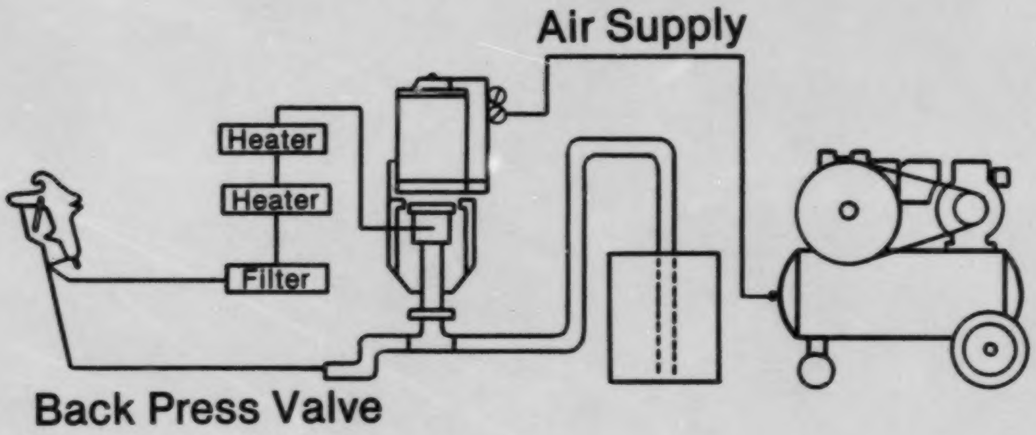

80/100 P.S.I. Air
From Compressor
80/100 P.S.I.
Safety Valve
160 P.S.I. Gauge
Compressed Air Receiver
Regulator
AIR
Gauge
Bleeder
Control
Valve
AIR CONTROL
AIR ATOMIZING
Bleeder
to Drain Air
and Condensate
Stop
Cock
Swing
Check
Valve
Paint or
Binder
Tank
(Paint Under Pressure)
Cock
Strainer
Paint to Gun
Paint Gun

Used with permission of Prismo Universal Corporation.

Typical Spray Systems: Siphon Feed and Airless Atomization

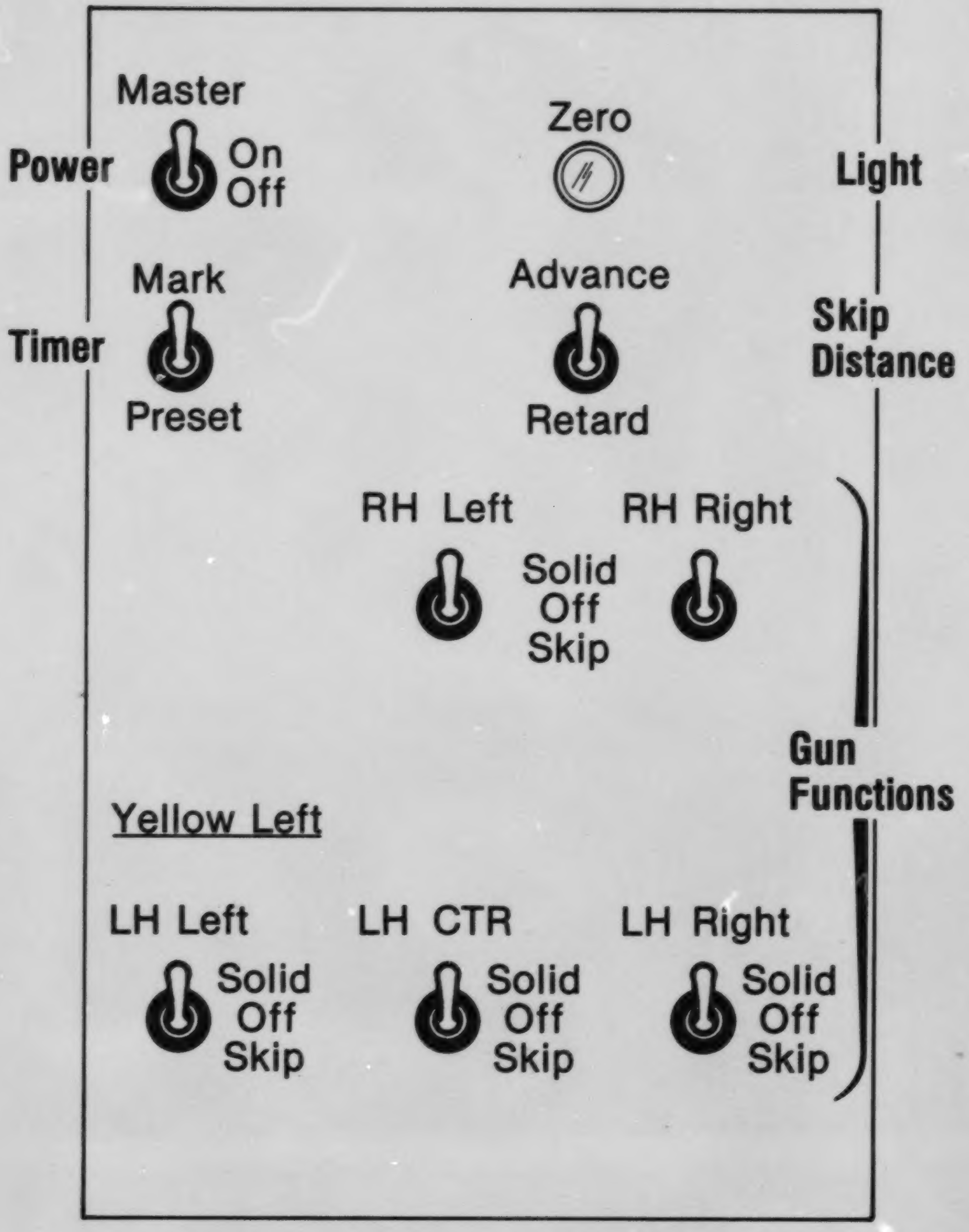

Oil and Water Extractor
Air Inlet
Fluid
Air Hose
Siphon Cup

Airless Atomization (Heated)

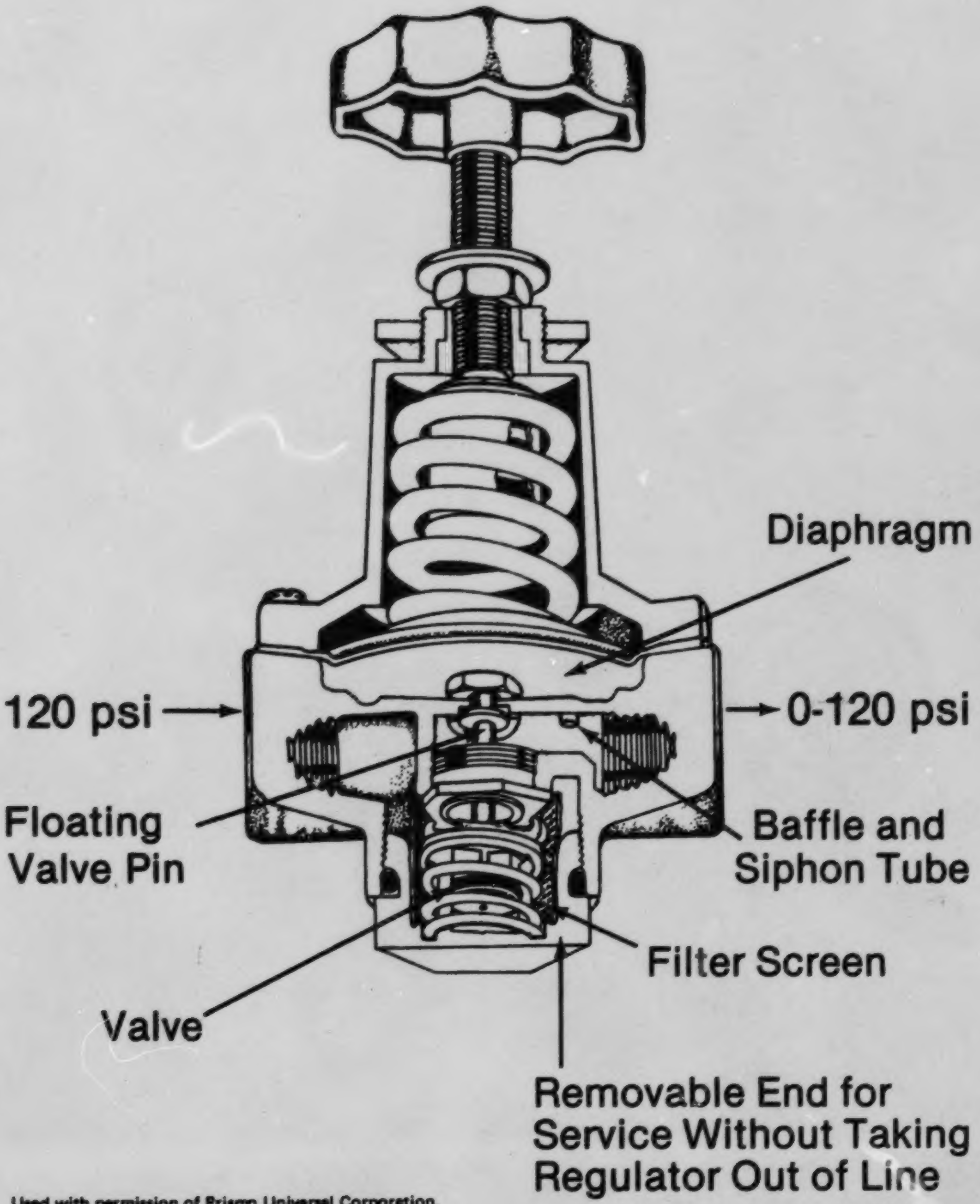

Air Supply
Heater
Heater
Filter
Back Press Valve

Used with permission of Binks Manufacturing Company.

Typical Switch Box Controls


Master
Power
On
Off
Zero
Light
Mark
Timer
Preset
Advance
Retard
Skip
Distance
RH Left
RH Right
Solid
Off
Skip
Gun
Functions
Yellow Left
LH Left
Solid
Off
Skip
LH CTR
Solid
Off
Skip
LH Right
Solid
Off
Skip

Parts of a Pressure Regulator


Diaphragm
120 psi
0-120 psi
Floating Valve Pin
Baffle and Siphon Tube
Filter Screen
Valve
Removable End for Service Without Taking Regulator Out of Line

Used with permission of Prismo Universal Corporation.

STRIPING AND PAINTING EQUIPMENT
UNIT XIV

ASSIGNMENT SHEET #1--IDENTIFY CONTROL POSITIONS FOR ROAD MARKINGS

NAME ________________________________ SCORE ____________

Switching controls to change markings takes concentration and practice. It is the real skill of the striping machine operator. Use this assignment sheet to give yourself mental practice in switching gun functions.

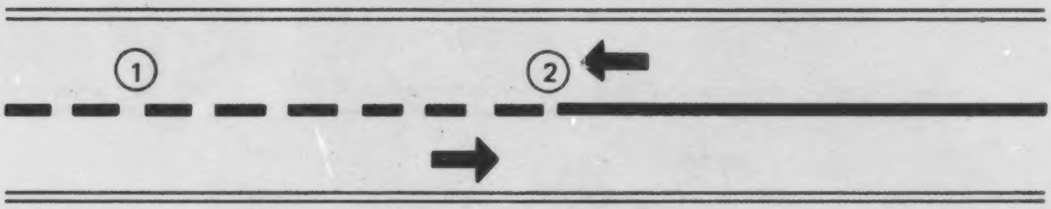
Use Transparency #6, "Switch Box Controls," as a model. Assume that on your striping machine the LH LEFT gun angles at 45 degrees for painting curbs, and the LH CENTER and LH RIGHT guns are for painting the center line.

PART I

In the drawings below, each number marks a place where the operator must change the striping: switch a nozzle on or off, change from solid to skip, and so on. Below the drawings are the switch positions for the left carriage control panel.

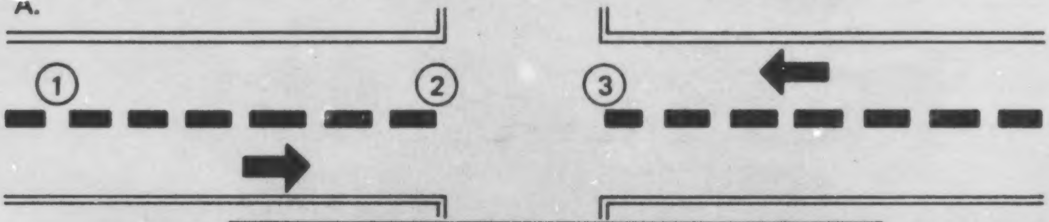
Decide which position is correct for each gun at the numbered places, and write the numbers in the blanks. Follow the example below.

EXAMPLE:



LH LEFT	LH CENTER	LH RIGHT
____ SOLID	2 SOLID	____ SOLID
1, 2 OFF	____ OFF	1, 2 OFF
____ SKIP	1 SKIP	____ SKIP

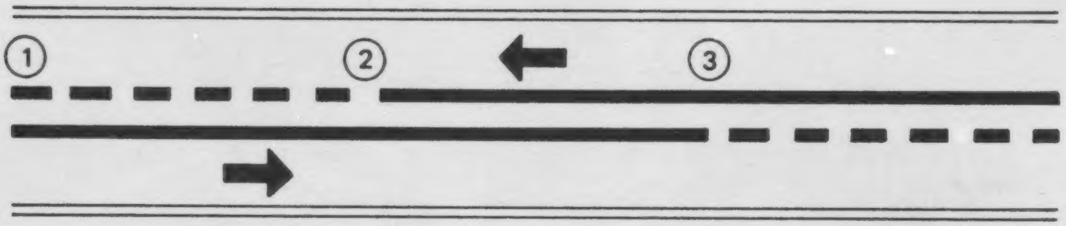
A.



LH LEFT	LH CENTER	LH RIGHT
____ SOLID	____ SOLID	____ SOLID
____ OFF	____ OFF	____ OFF
____ SKIP	____ SKIP	____ SKIP

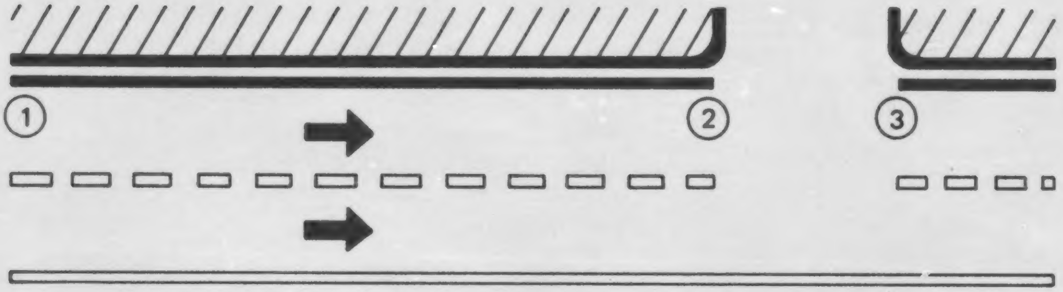
ASSIGNMENT SHEET #1

B.



LH LEFT	LH CENTER	LH RIGHT
_____SOLID	_____SOLID	_____SOLID
_____OFF	_____OFF	_____OFF
_____SKIP	_____SKIP	_____SKIP

C.



LH LEFT	LH CENTER	LH RIGHT
_____SOLID	_____SOLID	_____SOLID
_____OFF	_____OFF	_____OFF
_____SKIP	_____SKIP	_____SKIP

ASSIGNMENT SHEET #1

PART II

Answer the following questions for the striping situation depicted in Part I, C. Write an "X" in the blank before each correct answer.

A. What color should the dashes be?

_____ 1. White

_____ 2. Yellow

B. Which gun should be used to paint the dashes?

_____ 1. LH CENTER

_____ 2. RH RIGHT

_____ 3. LH RIGHT

_____ 4. RH LEFT

_____ 5. LH LEFT

C. What color should the edge line be?

_____ 1. White

_____ 2. Yellow

D. Which gun should be used to paint the edge line?

_____ 1. LH CENTER

_____ 2. RH RIGHT

_____ 3. LH RIGHT

_____ 4. RH LEFT

_____ 5. LH LEFT

STRIPING AND PAINTING EQUIPMENT
UNIT XIV

ANSWERS TO ASSIGNMENT SHEET

Assignment Sheet #1

PART I

A.

LH LEFT		LH CENTER		LH RIGHT	
	SOLID		SOLID		SOLID
1, 2, 3	OFF	2	OFF	1, 2, 3	OFF
	SKIP	1, 3	SKIP		SKIP

B.

LH LEFT		LH CENTER		LH RIGHT	
	SOLID	2, 3	SOLID	1, 2	SOLID
1, 2, 3	OFF		OFF		OFF
	SKIP	1	SKIP	3	SKIP

C.

LH LEFT		LH CENTER		LH RIGHT	
1, 3	SOLID	1, 3	SOLID		SOLID
2	OFF	2	OFF	1, 2, 3	OFF
	SKIP		SKIP		SKIP

PART II

A. 1

B. 2

C. 1

D. 2

STRIPING AND PAINTING EQUIPMENT
UNIT XIV

JOB SHEET #1--PERFORM PRESTART INSPECTION AND MAINTENANCE PROCEDURES ON A STRIPING MACHINE

I. Equipment and materials

- A. Striping machine
- B. Operator's manual
- C. Engine oil
- D. Engine coolant
- E. Hydraulic fluid
- F. Fuel
- G. Solvent
- H. Lubricants
- I. Grease gun
- J. Rags

II. Procedure

(NOTE: Deficiencies should be corrected immediately or reported to the proper authority. Do not operate defective equipment.)

- A. Make a walk-around visual inspection for broken, worn, or missing parts, and leaks
- B. Check compressor engine oil level; add or change engine oil if necessary
- C. Check hydraulic reservoir level; add fluid if necessary
- D. Check fuel level; fill tanks if necessary
- E. Check compressor air cleaner; remove and clean filter if necessary
- F. Clean all grease fittings and lubricate according to manufacturer's specifications
- G. Check hydraulic system for leaking lines or connections, bent or kinked lines, and lines rubbing against other parts
- H. Check electrical wire connections and insulation
- I. Check levers and controls for proper functioning

JOB SHEET #1

J. Remove trash

K. Check lights

L. Check safety devices

M. Check paint level in tanks

N. Check condition of lines and hoses

O. Check that valves are in correct open or closed position

P. Check condition of nozzles; clean shrouds if necessary

Q. Check pumps

R. Check pressure gauges and regulators for all material tanks

STRIPING AND PAINTING EQUIPMENT
UNIT XIV

JOB SHEET #2--SERVICE A STRIPING MACHINE

I. Equipment and materials

- A. Striping machine
- B. Operator's manual
- C. Tool kit
- D. Grease gun
- E. Lubricants
- F. Cleaning solvents
- G. Rags
- H. Water
- I. Engine coolant
- J. Engine oil
- K. Hydraulic fluid
- L. Fuel

II. Procedure

(NOTE: Follow departmental preventive maintenance program when servicing equipment. Refer to operator's manual for lubrication chart and for servicing specific components and attachments.)

A. Visually inspect for leaks and broken, worn, or missing parts

(NOTE: Major repairs and replacements should be reported to the proper authority and completed by a trained mechnanic.)

B. Check compressor engine oil level, filter, lines, and hoses; add engine oil if needed

C. Check compressor engine coolant level, radiator cap, hose, and radiator; add coolant if needed

(CAUTION: Do not remove radiator cap unless engine is cool; then, open cap slowly to release pressure.)

D. Clean air filter; replace if necessary

JOB SHEET #2

E. Check fuel level, fuel filters, and sediment bowl (where applicable); fill fuel tank if necessary

F. Check hydraulic fluid level, filters, hoses, lines, and fittings; look for leaks; add fluid if needed

G. Check wiring, insulation, and connections

H. Clean and lubricate all grease fittings according to manufacturer's recommendations

I. Check all safety devices; repair if necessary

J. Check major components and/or accessories

K. Check all systems for proper functioning

L. Check air and material lines for leaks and poor connections; replace if necessary

M. Check pumps for proper functioning; adjust as needed

N. Check guns and nozzles for wear and proper functioning; adjust or replace as needed

O. Check regulators for proper functioning; repair or adjust if necessary

(NOTE: Check diaphragm and needle valve if regulator is not working properly.)

STRIPING AND PAINTING EQUIPMENT
UNIT XIV

JOB SHEET #3--START, WARM UP, LOAD PAINT, OPERATE, AND SHUT DOWN A STRIPING MACHINE

I. Equipment, materials, and personnel

   A. Striping machine

   B. Operator's manuals for striping machine, pumps, compressor, guns

   C. Wrenches

   D. Paint (yellow and white)

   E. Solvent

   F. Glass beads

   G. Truck operator

   H. Crew members as needed for operation and signaling

II. Preparation for striping

   (NOTE: These are *general* procedures for operating a striper. Check with your instructor for specific procedures for your machine.)

   A. Perform all prestart inspection and maintenance procedures

   B. Start compressor, if used, and allow it to warm up

   C. Locate and identify all controls, lines, and valves for your unit

   D. Be sure valves are in the correct open or closed positions

   E. Load paint according to type of unit

      EXAMPLES: Pressure pot--Open barrels, stir paint, insert pump line, open main valves, turn on pumps

      Pump feed--Release hoist, secure barrels on hoist, lift onto truck, open barrels, insert pump line

   F. Load beads

   G. Start agitators if used

   H. Start heaters if used

JOB SHEET #3

I. Start pumps

J. Lower carriage

K. Set gun height and angle by loosening set screws, adjusting nozzle, and then tightening screws

L. Blow out lines with solvent

M. Run paint through guns; check pattern

(NOTE: Use rags, bead bags, or some other material to catch paint.)

N. Make adjustments as needed

(NOTE: See operator's manual for spray guns.)

EXAMPLES: Adjust air valve
Adjust fluid intake valve
Clean regulator
Adjust pattern control
Clean nozzle tip
Clean needle valve
Clean shroud
Adjust height or angle of guns

O. Raise carriages

P. Set cycle according to departmental standards

Q. Set footmeter to zero

R. Signal other crew members when adjustments are complete

S. Signal truck operator to move to practice area

(NOTE: Driver will pull to the side for final adjustments just before painting is to begin.)

III. Procedure for striping

A. Make sure all controls are in proper preset positions

EXAMPLES: Pressure regulators set
Control valves on if so equipped
Gun controls on switch box in OFF position

B. Lower timing wheel

C. Take position at right operator's station

JOB SHEET #3

D. Lower carriage

E. Activate master switch

F. Activate timing system

G. Signal truck operator that you are ready

H. At operator's signal, activate right gun, right-hand carriage to paint edge line

I. Practice stopping and starting line as needed

J. Adjust position of carriage as needed to keep line straight and even and matched with existing line

K. At end of practice, turn switches off and signal truck operator (or operator will signal you when truck reaches end of practice area)

L. Move to left operator's station

(NOTE: If no other student is to replace you on the right side, retract the carriage, raise it, and secure the safety chains.)

M. Check all valves and switches for proper preset positions

N. Lower and extend left carriage if not already in place

O. Signal truck operator when you are ready

P. At operator's signal, switch on outside gun and paint a solid line

Q. Operate all guns in solid and skip pattern

R. Practice advancing and retarding the skip

(NOTE: Jog switch on and off quickly; hold it in position for a second or less. Then return to the OFF position.)

S. Practice switching for different markings

EXAMPLES: Skip line
No passing zone
Double yellow line
Switch off all guns
Double yellow line at intersection approaches, changing to skip and single line
No passing zone for 500 feet; then skip line

T. Keep lines straight and aligned with existing lines

U. Make adjustments or corrections *very slowly*

V. Signal driver to stop when practice is completed or if any problems arise

(NOTE: Should operation stop at any time, use that opportunity to clean the shrouds.)

W. At end of practice, shut off guns

X. Scrape shrouds

Y. Shut off paint; open solvent valve to clean lines and guns

Z. Shut off guns

AA. Raise timing wheel

BB. Retract and raise carriages and secure safety chains

CC. Shut down regulators

DD. Shut down as equipped: heaters, pumps, compressor

(NOTE: Allow compressor to run at idle with no load for three to five minutes.)

STRIPING AND PAINTING EQUIPMENT
UNIT XIV

JOB SHEET #4--PAINT HIGHWAY STRIPES

I. Equipment, materials, and personnel

- A. Striping unit--Truck with all striping equipment mounted on or attached to it
- B. Operator's manual
- C. Supply truck
- D. Escort patrol car
- E. Paint (white and yellow)
- F. Glass beads
- G. Supervisor
- H. Crew

  (NOTE: It is suggested that each crew member be trained to perform all tasks connected with highway striping.)

  1. Truck operator
  2. Right-side striper carriage operator
  3. Left-side striper carriage operator
  4. Patrol escort (optional)
  5. Supply truck driver
- I. Recommended safety equipment
  1. Gloves (all personnel)
  2. Goggles (offside spray control and striper driver)
  3. Respirator (offside spray control and striper driver)
  4. Close-fitting clothing (all personnel)
  5. Fire extinguishers
  6. First-aid kit

II. Procedure

(NOTE: Painting highway stripes is a team effort. This procedure is based on this fact.)

JOB SHEET #4

A. Make visual inspection of equipment involved in your assignment; make minor repairs and adjustments as needed

B. Inspect spray nozzles; clean or adjust if necessary

C. Load required paint as directed by supervisor

D. Fill glass bead hopper with beads

E. Travel to work site

F. Have all personnel take their assigned positions

(NOTE: Truck operator will park off the roadway while adjustments are made.)

G. Start heaters (if needed), compressors (if used), agitators, and pumps

(NOTE: See operator's manuals.)

H. Run paint through lines and nozzles; check pattern and adjust as needed

I. Truck operator positions striping unit on roadway so that left-side carriage is lined up with center line on two-way, two-lane road; sets parking brake

(NOTE: If one of the older models is being used, the main striper is sometimes attached to the center of the striping unit. In this case, the striping unit will be centered over the center line and the offside striping unit attached to an outrigger.)

J. Release and lower carriages

K. If used, position escort patrol car just ahead of striping unit on a two-way traffic road or just back of striping unit on divided highway

L. Truck operator places gear shift lever in desired driving range, releases brake, and moves forward, guiding unit along line to be striped as accurately as possible at the predetermined speed

M. Procedure for left-side carriage operator

1. Activate paint nozzles and bead valves; place solid lines and skip lines as indicated

   (NOTE: Layout crews will have markers on new pavement. Paint over existing lines on pavement that has been striped before.)

2. Use steering wheel to adjust for variations

3. Signal truck operator if trouble develops or if paint or beads run out

   (NOTE: Truck operator should stop immediately and, if possible, park off the roadway with the emergency brake set.)

JOB SHEET #4

N. Procedure for right-side or offside carriage operator

   1. Activate paint nozzles and bead valves to place edge line

   2. Use steering wheel to adjust for variations

   3. Watch ahead and listen to intercom for signals for off-striping

      EXAMPLE: Any place such as intersections or driveways where traffic may cross the edge line

   4. Signal truck operator and left-side carriage operator if trouble develops

      (NOTE: Truck operator should stop immediately and, if possible, park off the roadway with the emergency brake set.)

O. Correct the problem if trouble is in one of the carriages or nozzles

P. Refill paint tanks and bead hoppers as needed

   (NOTE: The supply truck will park beside the striping unit and transfer the paint.)

Q. When paint tanks and bead hoppers are filled, resume striping

R. Continue this procedure until programmed striping of roadway is completed

S. Raise and secure carriages and timing wheel

T. Shut down accessory equipment on striping unit

U. Move striping unit to next job site

   (NOTE: If striping is completed for the day, park unit in a safe and fairly level place.)

V. Follow clean-up procedure

W. Follow shut-down procedure

STRIPING AND PAINTING EQUIPMENT
UNIT XIV

JOB SHEET #5--PERFORM PRESTART INSPECTION AND MAINTENANCE PROCEDURES ON A HAND STRIPING MACHINE

I. Equipment and materials

A. Hand striping equipment

B. Operator's manual

C. Engine oil

D. Solvent

E. Fuel

F. Lubricants

G. Grease gun

H. Rags

II. Procedure

(NOTE: Deficiencies should be corrected immediately or reported to the proper authority. Do not operate defective equipment.)

A. Make a walk-around visual inspection for broken, worn, or missing parts, and leaks

B. Check engine oil level; add engine oil if necessary

C. Check fuel level; fill tank if needed

D. Check battery connections for tightness and corrosion

E. Check battery electrolyte level; add water if needed

F. Check air cleaner; remove and clean filter if necessary

G. Check tires

H. Clean all grease fittings and lubricate according to manufacturer's specifications

I. Check drive belts for tightness

J. Check electrical wire connections and insulation

K. Check gauges

JOB SHEET #5

L. Check levers and controls for proper functioning

M. Remove trash

N. Check lights

O. Check safety devices

P. Check guns for wear and proper operation

Q. Check paint tank for dirt; clean if necessary

R. Check bead dispenser for proper functioning

S. Check lines for leaks

U. Lubricate wire valve

V. Check shroud; clean if necessary

STRIPING AND PAINTING EQUIPMENT
UNIT XIV

JOB SHEET #6--START, WARM UP, OPERATE, CLEAN, AND SHUT DOWN A HAND STRIPING MACHINE

I. Equipment, materials, and personnel

  A. Hand striping machine

  B. Operator's manual

  C. Paint

  D. Glass beads

  E. Screen or paint filter

  F. Wrenches

  G. Bucket

  H. Funnel

  I. Masking

  J. Crew to mask

  K. Rags

II. Procedure

  A. Perform all prestart inspection and maintenance procedures

  B. Be sure all valves and controls are in proper preset position

  C. Remove lid and check paint tank for dirt; clean if necessary

  D. Set gun to correct height and angle for job

  E. Start engine, set throttle about one-quarter to one-third open; allow engine to warm up

  F. Pump or pour paint into bucket

JOB SHEET #6

G. Place screen across top of paint tank; pour paint into tank (Figure 27)

(NOTE: Clean screen with solvent after use.)

FIGURE 27

H. Replace paint tank lid and secure

(NOTE: Position lid on tank so that coupler on lid is aligned with hose coupling.)

I. Connect air hose to paint tank

J. Check solvent level; add solvent if needed, using funnel

K. Fill bead tank

L. Set air pressure regulator to manufacturer's recommended pressure; allow pressure to built up

M. Remove, clean, and replace shroud

N. Set selector switch to ATOMIZE

O. Push trigger and blow paint through gun; check pattern and paint flow

JOB SHEET #6

P. Make adjustments as needed for correct paint and bead pattern

(NOTE: Paint should turn on and off completely and immediately. No paint should dribble out; spray fan should have clean edges; paint should flow smoothly; beads should fall evenly.)

EXAMPLES: Adjust air valve
Adjust fluid intake valve
Adjust air pressure
Adjust pattern control
Clean nozzle tip
Clean needle valve
Adjust height or angle of guns

Q. Turn selector switch to OFF and move unit to practice area

R. Position machine to paint stripe

S. Turn selector switch to ATOMIZE (or PAINT, etc.)

T. When gun reaches beginning of stripe, press trigger and paint stripe

U. Release trigger at end of stripe

V. Push machine past end of stripe, back up, and reposition machine

W. Practice striping until you can paint a straight and even stripe 10 feet long

X. Stop; set selector switch to OFF

Y. Remove, clean, and replace shroud

Z. Blow solvent through gun

(NOTE: The following procedure is for an MB Model 5-10. Check operator's manual for your machine.)

1. Set pressure regulator to zero, and wait for pressure to drop
2. Relieve pressure at pressure relief valve
3. Disconnect air line at tank and connect to solvent tank
4. Set pressure regulator to correct pressure; allow pressure to build
5. Close paint line valve
6. Open solvent line valve
7. Set selector switch to SOLVENT

JOB SHEET #6

8. Press trigger and quickly release; blow solvent through guns until it runs clear

9. Set selector switch to OFF

10. Set pressure regulator to zero; wait for pressure to drop

11. Relieve pressure

12. Disconnect air line at solvent tank and connect to paint tank

13. Set pressure regulator to correct pressure

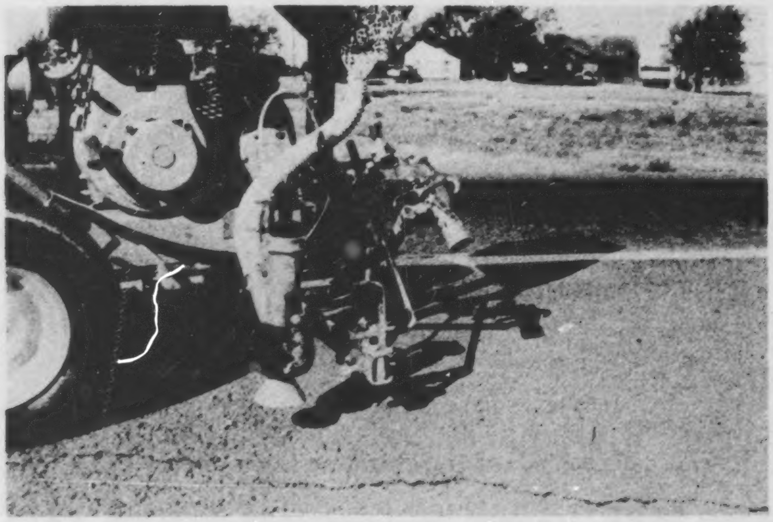
14. Close solvent line valve

15. Open paint line valve

AA. Reset gun angle to about 45 degrees and raise it to about 8 inches off ground (Figure 28)

(NOTE: Loosen set screws, change height and angle on rod, and then tighten set screws.)

FIGURE 28



BB. Close valve on bead line

CC. Repeat painting procedure on curb area

(NOTE: Use masking, if available. Crew members hold masking upright at line where curb meets sidewalk.)

JOB SHEET #6

III. Clean and shut down machine

- A. Move machine to dumping area
- B. Run remaining paint from tank or pump back into barrel
- C. Set selector switch to OFF position
- D. Set pressure regulator to zero; wait for pressure to drop
- E. Relieve pressure from line at pressure relief valve
- F. Disconnect air line from tank lid if machine is so designed
- G. Remove lid
- H. Pour solvent into paint tank
- I. Clean inside of tank
- J. Replace lid
- K. Connect air line if removed
- L. Set pressure regulator to correct pressure; allow pressure to build
- M. Set selector switch to ATOMIZE (or PAINT, etc.)
- N. Press trigger and run solvent out of tank
- O. Set pressure regulator to zero
- P. Press trigger and release air from tank
- Q. Relieve pressure with pressure relief valve
- R. Shut down engine
- S. Disconnect air hose if machine is so designed
- T. Remove lid
- U. Wipe down inside of tank
- V. Remove shroud and nozzle parts and soak in solvent
- W. Clean nozzle parts and replace on gun
- X. Load machine on trailer and secure, or store indoors, covered

STRIPING AND PAINTING EQUIPMENT
UNIT XIV

JOB SHEET #7--PAINT STRIPES ON A PARKING LOT USING A HAND STRIPING MACHINE

I. Equipment and materials

   A. Hand striping machine

   B. Operator's manual

   C. Transport vehicle

   D. Paint

   E. Recommended safety equipment

      1. Visible vest

      2. Goggles

      3. Gloves

      4. Respirator

      5. Hard hat

   F. Masking

   (NOTE: Surface should be swept clean and arrangements made for adequate masking for this job.)

II. Procedure

   A. Read operator's manual thoroughly

   B. Barricade entrances to parking lot

   C. Make a visual inspection of striping machine; adjust or repair any minor deficiencies

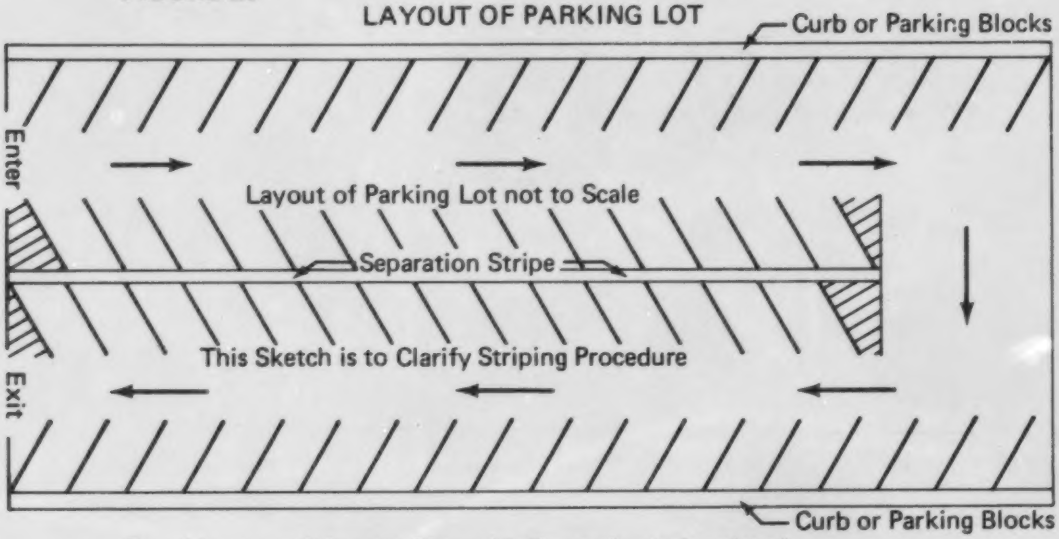
   D. Fill paint tank

JOB SHEET #7

E. Study area and plan painting cycle (Figure 29)

FIGURE 29

LAYOUT OF PARKING LOT


Curb or Parking Blocks
Enter
Layout of Parking Lot not to Scale
Separation Stripe
This Sketch is to Clarify Striping Procedure
Exit
Curb or Parking Blocks

F. Line up striping machine with first stripe to be placed

(NOTE: If striping along sides or ends of lot, start at end of stripe away from parking blocks or curb. Parking lines are marked, indicating where lines are to start and end, and the distance between.)

G. Perform starting procedure

H. Push machine forward at striping speed

(NOTE: See operator's manual.)

I. Open nozzle valve as nozzle reaches starting point

(NOTE: Some models are self-propelled. Check operator's manual for recommended travel speed.)

J. Complete this stripe

K. Close nozzle valve as striping machine comes to a stop

L. Check for accuracy and quality of stripe and make adjustments if necessary

M. Back striping machine to starting point and line up for next stripe

(NOTE: Do not cross fresh paint.)

N. Repeat steps H through K

JOB SHEET #7

O. Continue this procedure until all side and end stripes have been placed

(NOTE: If parking lot is wide enough for two or more rows of cars parked front to front, or if there are no parking blocks, the procedure will change for the inner parking striping.)

P. Line up striping machine with first stripe to be placed

Q. Repeat steps G through L

R. Turn striping machine around and move to next stripe

S. Line machine up with stripe layout

T. Repeat steps H through K.

U. Continue this procedure until all inner parking stripes have been placed

V. Line up striping machine with longitudinal parking separation stripe

W. Repeat steps H through K

X. Follow clean-up procedure

Y. Perform shutdown procedure

Z. Store hoses and nozzles in proper places

STRIPING AND PAINTING EQUIPMENT
UNIT XIV

TEST

NAME ______________________________ SCORE ____________

1. Match terms associated with striping and painting equipment to their correct definitions. Write the correct numbers in the blanks.

_____a. Solid stripe along outside of traffic lane

_____b. Painted part of a skip line

_____c. Attachment for striping machine or hand striping machine, or a separate unit with its own paint source; used to paint curbs or stripe small areas

_____d. Broken center line

_____e. Object that keeps paint off surfaces next to those being painted

_____f. Flashing lights that direct traffic flow

_____g. Paint atomized as it shoots out of gun

_____h. Small spray paint unit; used to paint curbs and stripe small areas

_____i. Yellow dashed or solid line indicating passing and no-passing zones on two-lane, two-way roadways

_____j. Paint atomized inside spray gun

_____k. Device for stirring paint to keep it from separating

_____l. Unpainted part of a skip line

_____m. Air or pump pressure forcing material through lines

_____n. To reduce to a fine spray by the tearing action of air

_____o. Dash-skip pattern beginning at start of one dash and ending at start of next dash

1. Pressure feed
2. External atomization
3. Agitator
4. Edge line
5. Masking
6. Skip
7. Two-lane center line
8. Hand striping machine
9. Dash
10. Arrow board
11. Internal atomization
12. Hand spray gun
13. Skip line
14. Atomize
15. Cycle

TEST

______p. Computerized device for operating paint and bead guns in cycle

______q. Material flowing downward toward lowest point

______r. Truck-mounted spray paint equipment; used to stripe road surfaces

______s. Device that sends electrical impulses to set cycle and measure number of feet painted

______t. Cover or guard which focuses spray pattern and makes a clean edge

______u. Device that removes condensed water and oil from air lines

______v. Device that maintains pressure at a preset level

______w. Glass spheres embedded in the paint to reflect light

______x. Line which guides approaching traffic around obstacles; also marks departures, such as exit ramps, from main roadway; usually V-shaped

______y. Dashed white lines separating traffic traveling in the same direction

______z. Mark identifying areas such as islands and gores, where traffic is prohibited

16. Separator
17. Regulator
18. Striping machine
19. Shroud
20. Hash mark
21. Solid-state timer
22. Timing wheel
23. Glass beads
24. Gravity feed
25. Multilane roadway lane lines
26. Gore

2. Match types of road markings to their correct descriptions. Write the correct numbers in the blanks.

______a. Center line for no passing in driver's lane

______b. Edge lines for multilane roadway

______c. Skip center line for two-lane roadway

______d. Center line for no passing in both lanes

______e. Edge line for two-lane, two-way roadway

______f. Lane line for multilane roadway

1. White dash-skip cycles
2. Solid yellow line on left-hand edge; solid white line on right-hand edge
3. Yellow dash-skip cycles
4. Two solid yellow lines
5. Solid white line on right-hand edge
6. Solid yellow line to driver's left

TEST

3. Match types of paint delivery systems to their correct descriptions. Write the correct numbers in the blanks.

_____a. Material is pumped from an unpressurized tank, agitated, fed to high pressure pumps, and sprayed under extreme pressure

_____b. Material is gravity-fed to a diaphragm or gear pump and then pumped under pressure to guns

_____c. Material is moved by air pressure from pressurized tanks to guns

_____d. Material is drawn by suction from holding tank to gun

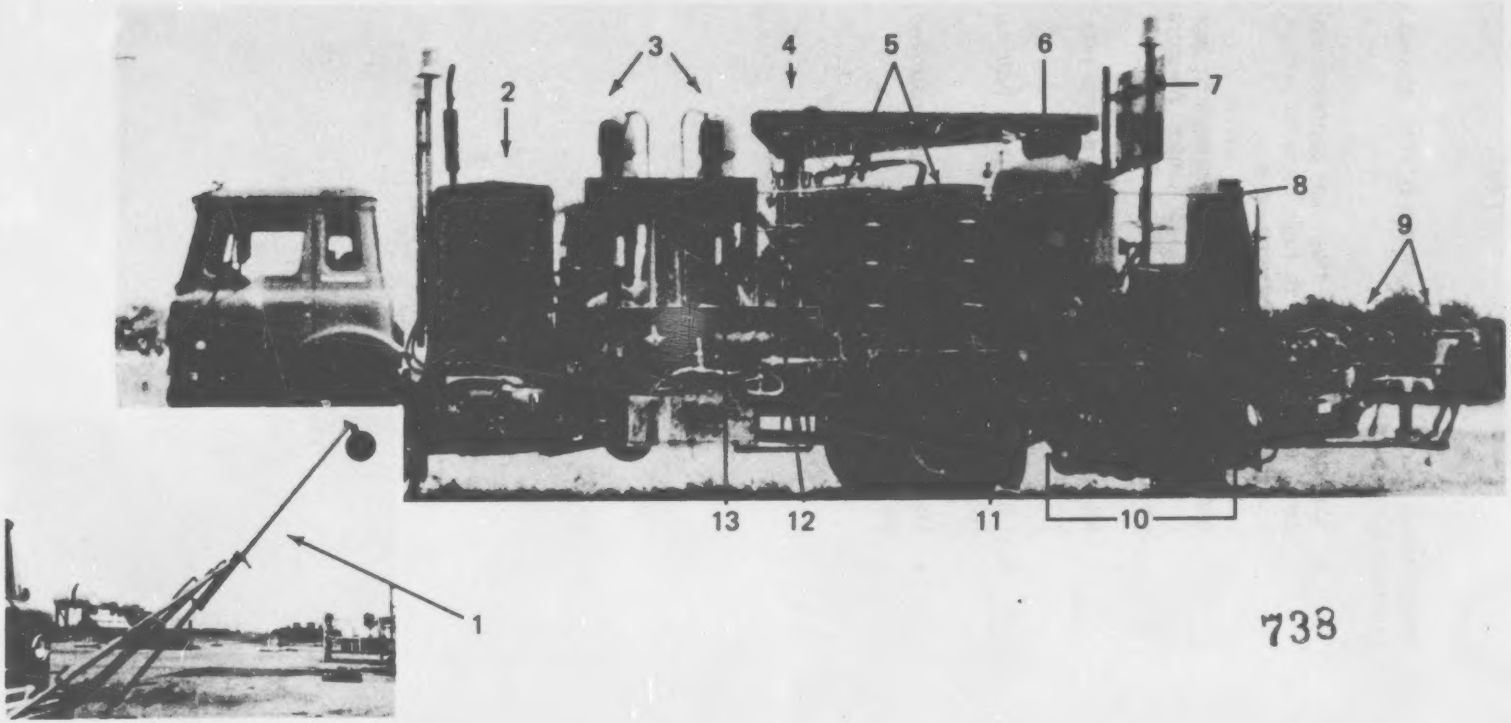
_____e. Material is pumped from unpressurized barrels or tanks to guns

1. Siphon feed
2. Airless atomization
3. Pressure pot
4. Zero-pressure feed
5. Pump-pressure feed

TEST

4. Identify parts of a pump-pressure-system striping machine. Write the correct numbers in the blanks.

______a. Arrow board
______b. Operator stations
______c. Alcohol tank
______d. Paint barrels
______e. Line guide
______f. Carriage
______g. Filters
______h. Main control board
______i. Bead tank
______j. Transfer pumps
______k. Air compressor
______l. Surge tanks
______m. Hoist



TEST

5. Match pump pressure operating systems to their correct descriptions. Write the correct numbers in the blanks.

_____a. Compressed air operates pumps, carriages, and timing wheel

_____b. Collects supply of paint for delivery to guns; keeps pressure constant at nozzles

_____c. Transfer pump moves paint from barrels through filter to surge tank and then to left gun; has crossover line to right

_____d. Pump on barrel or tank moves solvent to guns for cleaning lines and nozzles

_____e. Transfer pump moves paint from barrels through filter to surge tank and then to right gun; has crossover line to left

_____f. Pump moves material into air lines between filter and guns to keep out condensation in cold weather

1. White paint system
2. Yellow paint system
3. Surge tank
4. Alcohol system
5. Air system
6. Solvent system

TEST

6. Identify parts of a pressurepot-system striping machine. Write the correct numbers in the blanks.

a. Left side

_____ 1) **Heat exchanger**

_____ 2) **Main control panel**

_____ 3) **Paint tanks**

_____ 4) **Paint gun**

_____ 5) **Hydraulic fluid tank**

_____ 6) **Carriage**

_____ 7) **Glycol tank**

_____ 8) **Line guide**

_____ 9) **Bead gun**

_____ 10) **Screen-wire strainer**

_____ 11) **Air compressor**

_____ 12) **Left operator's station**

_____ 13) **Flasher**

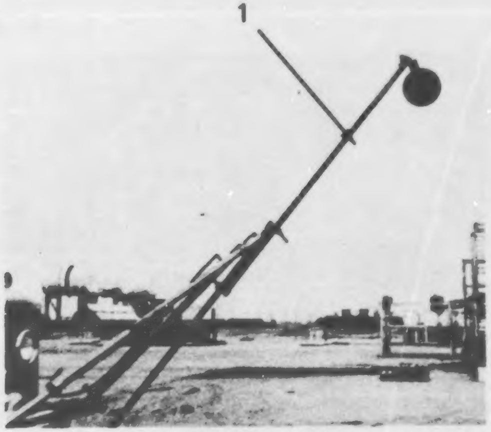
_____ 14) **Filter**

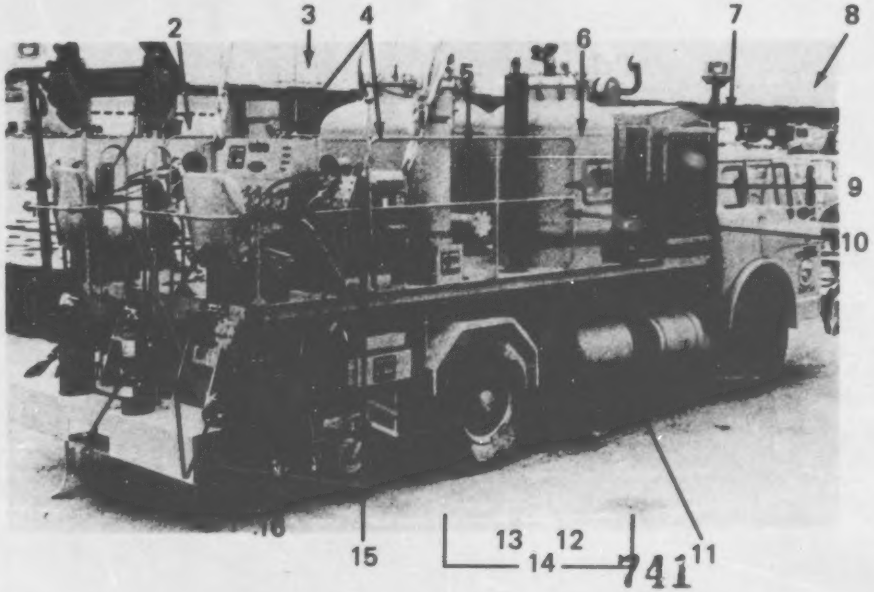
_____ 15) **Agitator**

_____ 16) **Bead tank**

_____ 17) **Arrow board**

_____ 18) **Engine and Compressor Fuel**





TEST

b. Right side

(NOTE: The right carriage has one or two guns for yellow and white edge line striping.)

_____ 1) Solvent tank

_____ 2) Paint tanks

_____ 3) Bead gun

_____ 4) Filling hose

_____ 5) Thermostat

_____ 6) Paint gun

_____ 7) Agitator

_____ 8) Heat exchanger

_____ 9) Right operator's station

_____ 10) Carriage

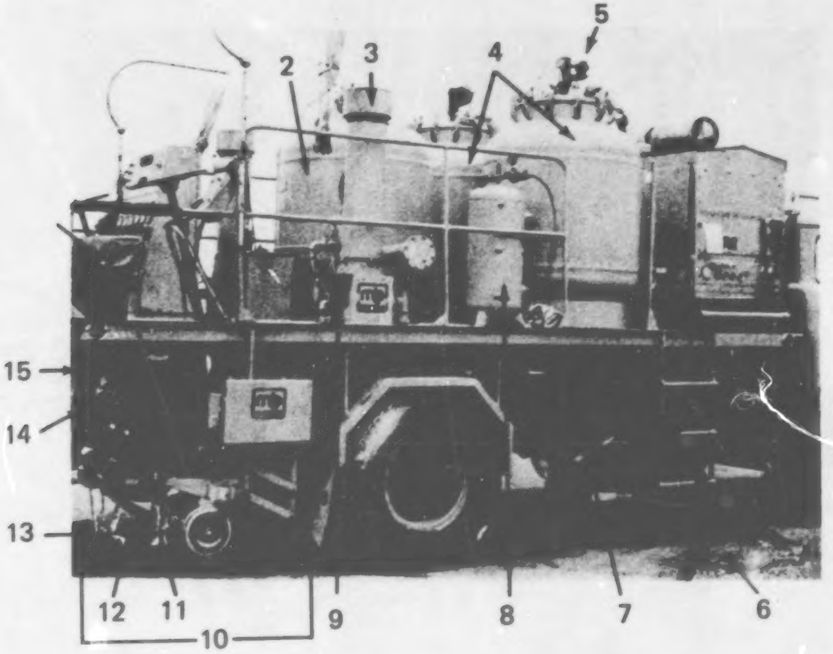
_____ 11) Filling pump

_____ 12) Bead tank

_____ 13) Hand spray connection

_____ 14) Screen-wire strainer

_____ 15) Timing wheel



TEST

7. Match pressure pot operating systems to their correct descriptions. Write the correct numbers in the blanks.

_____a. Glycol is heated and circulated through exchanger; paint line runs through exchanger and absorbs heat

_____b. Operates pump, carriages, and guide assembly

_____c. Material flows from tank through lines to nozzles; can be directed through individual atomizing air lines to nozzles as needed

_____d. Usually located on left side of truck with a crossover to the right; material under pressure flows from tank through filters, heat exchanger, screen strainer, and then to guns

_____e. Pressure forces material from tank to guns

_____f. Compressed air flows from compressor to pressure tanks, regulators, and nozzles

_____g. Usually located on right side of truck with a crossover to the left; material under pressure flows from tank through filters, heat exchanger, screen strainer, and then to guns

1. Solvent system
2. Heat exchange system
3. Yellow paint system
4. Hydraulic system
5. Air system
6. White paint system
7. Glass bead system

8. Match controls on a typical striping machine to their correct functions. Write the correct numbers in the blanks.

a. Main control board

____ 1) Register pressure in each system

____ 2) Sets dash and cycle length

____ 3) ON-OFF controls for main power, cab power, heat exchangers, circulating pump, flasher, and beacon

____ 4) Register temperature of glycol and yellow and white paint tanks

____ 5) Set operating pressure

____ 6) ON-OFF control for guns, and RAISE-LOWER control for carriages

1. Temperature gauges
2. Control valves
3. Power switches and indicator lights
4. Timer
5. Pressure gauges
6. Regulators

TEST

b. Switch box controls

____ 1) Turns on power

____ 2) Increases or decreases length of skip

____ 3) Activates timing system

____ 4) Activate solid line, skip line, or shutdown for each gun

____ 5) Indicates beginning of a cycle

1. Gun function switches
2. Master switch
3. Zero light
4. Advance-retard switch
5. Mark-preset switch

c. Other controls

____ 1) Control the flow of air and material; located on all lines

____ 2) Indicates number of feet of road surface painted by each gun

____ 3) Sets temperature (on heated-paint equipment only)

____ 4) Release excess pressure from tanks and lines

____ 5) Moves carriage in or out to place paint line

1. Footmeter
2. Flow valves
3. Heat exchanger control
4. Steering wheel
5. Pressure relief valves

9. Select from the following list procedures for regulating pump pressure. Write an "X" in the blank before each correct answer.

______a. Replace knob frequently

______b. Lower pressure by adjusting regulator and relieving pressure at relief valves

______c. Adjust alcohol pressure as needed

______d. Adjust pressure as needed for different road surfaces

______e. Set bead pressure and keep it steady

______f. Keep pressure adjusted so that paint is even and edges are clean

______g. Replace diaphragm and clean needle valve as needed

______h. Increase pressure if paint splatters

______i. Use lower pressure in the morning and increase pressure as paint is agitated

______j. Decrease pressure if paint splatters

TEST

______k. Keep pressure constant once it is set

______l. Increase pressure to gun if paint is thin or spotty

______m. Use higher pressure in the morning, and decrease pressure as cold paint warms up

10. Identify parts of a typical spray gun nozzle. Write the correct numbers in the blanks.

______a. Operating air intake

______b. Packing

______c. Shroud

______d. Piston spring

______e. Fluid intake

______f. Needle valve spring

______g. Fluid tip

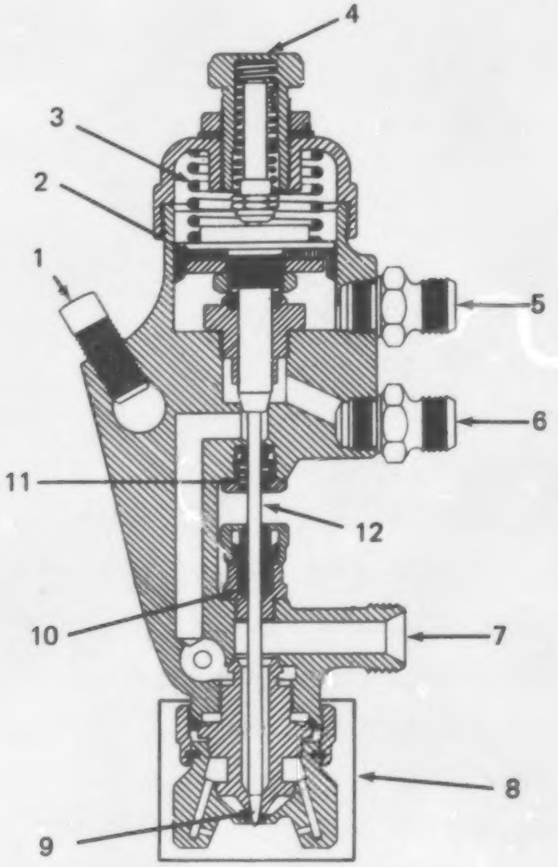
______h. Atomizing air intake

______i. Mounting lock-screw

______j. Fluid adjusting nut

______k. Needle

______l. Leather plunger (piston)



TEST

11. Identify parts of a typical hand spray gun. Write the correct numbers in the blanks.

_____a. Fluid control knob

_____b. Air intake

_____c. Gun body (or handle)

_____d. Pattern control

_____e. Air nozzle

_____f. Horn

_____g. Fluid packing nut

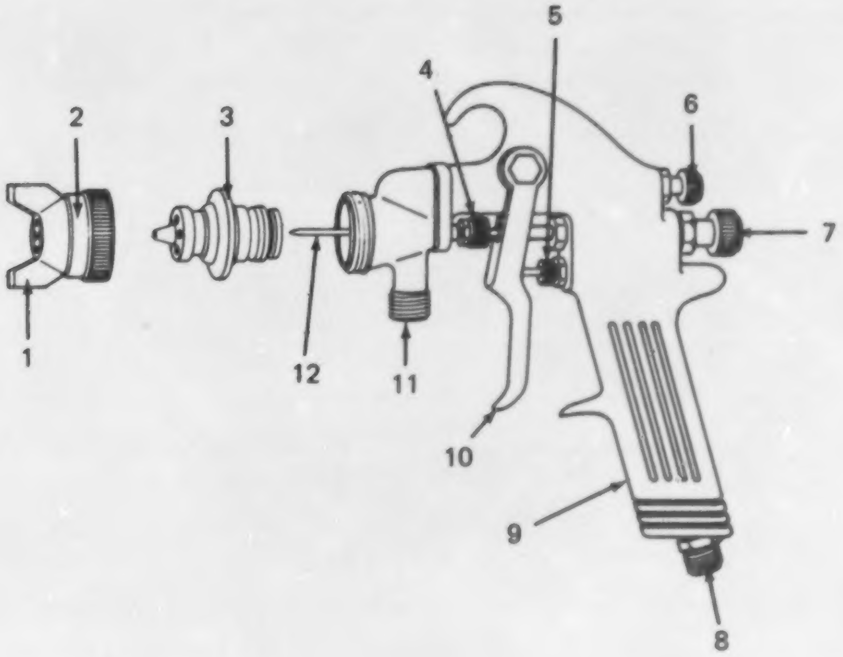
_____h. Trigger

_____i. Needle valve

_____j. Fluid nozzle

_____k. Air valve

_____l. Paint intake



TEST

12. Match spray gun components to their correct functions. Write the correct numbers in the blanks.

______a. Operates air valve and fluid needle

______b. Meters and directs paint into air stream; also forms seat for fluid needle to shut off flow

______c. Adjusts fluid volume (used with siphon feed only)

______d. Controls air flow through gun

______e. Directs compressed air through horn holes into paint stream, atomizing paint and forming spray pattern

______f. Shuts off flow through fluid nozzle

______g. Adjusts size of fluid-nozzle opening

1. Air nozzle
2. Fluid control
3. Fluid nozzle
4. Pattern control
5. Trigger
6. Air valve
7. Needle

13. State eight safety rules for operating a striping machine.

a. ____

b. ____

c. ____

d. ____

e. ____

f. ____

g. ____

h. ____

14. State twelve procedures for effective striping machine operation.

a. ____

b. ____

c. ____

d. ____

e. ____

f. ____

g. ____

TEST

h. ____________________

i. ____________________

j. ____________________

k. ____________________

l. ____________________

15. Identify parts of a typical hand striping machine. Write the correct numbers in the blanks.

_____a. **Bead box**

_____b. **Paint tank**

_____c. **Bead gun**

_____d. **Pressure gauges**

_____e. **Air compressor**

_____f. **Accessory air line**

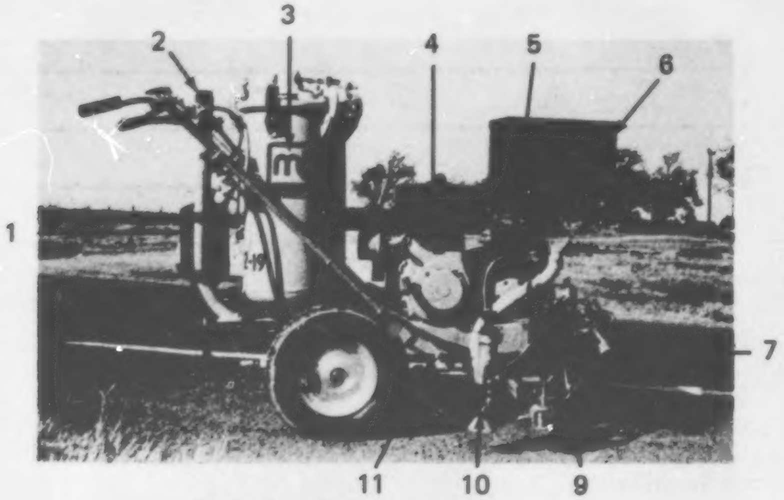
_____g. **Solvent tank**

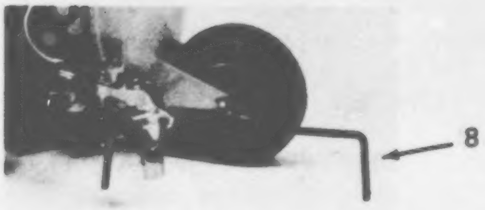
_____h. **Engine**

_____i. **Paint gun**

_____j. **Height and angle adjusting rod**

_____k. **Line guide**





TEST

16. Match controls on a typical hand striping machine to their correct functions. Write the correct numbers in the blanks.

_____a. Sends air to gun to atomize paint and operate bead dispenser

_____b. Set pressure at tank and gun

_____c. Register air pressure in paint tank, in overall system, and at paint gun

_____d. Opens and closes paint or solvent lines

_____e. Sets engine speed

1. Regulators
2. Throttle
3. Pressure gauges
4. Selector switch
5. Air valve switch

17. State ten procedures for safe and effective hand striping machine operation.

a. ______________________________

b. ______________________________

c. ______________________________

d. ______________________________

e. ______________________________

f. ______________________________

g. ______________________________

h. ______________________________

i. ______________________________

j. ______________________________

(NOTE: Test questions 18 and 19 list the assignment and job sheets. They are an important part of this test. If they have not been completed, check with your instructor.)

18. Identify control positions for road markings.

19. Demonstrate the ability to

   a. Perform prestart inspection and maintenance procedures on a striping machine.

   b. Service a striping machine.

   c. Start, warm up, load paint, operate, and shut down a striping machine.

   d. Paint highway stripes.

TEST

e. Perform prestart inspection and maintenance procedures on a hand striping machine.

f. Start, warm up, operate, clean, and shut down a hand striping machine.

g. Paint stripes on a parking lot using a hand striping machine.

STRIPING AND PAINTING EQUIPMENT
UNIT XIV

ANSWERS TO TEST

1. a. 4
   b. 9
   c. 12
   d. 13
   e. 5
   f. 10
   g. 2
   h. 8
   i. 7
   j. 11
   k. 3
   l. 6
   m. 1
   n. 14
   o. 15
   p. 21
   q. 24
   r. 18
   s. 22
   t. 19
   u. 16
   v. 17
   w. 23
   x. 26
   y. 25
   z. 20

2. a. 6
   b. 2
   c. 3
   d. 4
   e. 5
   f. 1

3. a. 2
   b. 4
   c. 3
   d. 1
   e. 5

ANSWERS TO TEST

4. a. 7
   b. 9
   c. 12
   d. 5
   e. 1
   f. 10
   g. 13
   h. 8
   i. 6
   j. 3
   k. 2
   l. 11
   m. 4

5. a. 5
   b. 3
   c. 2
   d. 6
   e. 1
   f. 4

6. a. Left side
   1) 6
   2) 9
   3) 4
   4) 13
   5) 18
   6) 14
   7) 16
   8) 1
   9) 12
   10) 11
   11) 2
   12) 10
   13) 8
   14) 15
   15) 3
   16) 5
   17) 7
   18) 17

   b. Right side
   1) 8
   2) 4
   3) 12
   4) 6
   5) 9
   6) 11

ANSWERS TO TEST

7) 5
8) 3
9) 1
10) 10
11) 7
12) 2
13) 14
14) 15
15) 13

7. a. 2
   b. 4
   c. 1
   d. 3
   e. 7
   f. 5
   g. 6

8. a. Main control board
      1) 5
      2) 4
      3) 3
      4) 1
      5) 6
      6) 2
   b. Switch box controls
      1) 2
      2) 4
      3) 5
      4) 1
      5) 3

ANSWERS TO TEST

c. Other controls
  1) 2
  2) 1
  3) 3
  4) 5
  5) 4

9. b, d, f, g, i. l, m

10. a. 5
  b. 10
  c. 8
  d. 3
  e. 7
  f. 11
  g. 9
  h. 6
  i. 1
  j. 4
  k. 12
  l. 2

11. a. 7
  b. 8
  c. 9
  d. 6
  e. 2
  f. 1
  g. 4
  h. 10
  i. 12
  j. 3
  k. 5
  l. 11

12. a. 5
  b. 3
  c. 2
  d. 6
  e. 1
  f. 7
  g. 4

ANSWERS TO TEST

13. Answer should include any eight of the following

    a. Read operator's manual thoroughly: know your machine

    b. Study departmental safety manual

    c. Wear a respirator when hand spraying

    d. Wear a visible vest when hand spraying

    e. Do not smoke while loading paint or flushing machine

    f. Relieve pressure before opening any pressurized tank or coupling

    g. Avoid contact with solvent

    h. Thoroughly clean solvent from skin as quickly as possible

    i. Keep machine clean

14. Answer should include any twelve of the following

    a. Perform all prestart inspection and maintenance procedures

    b. Set pressures according to manufacturer's recommendations

    c. Know all controls and their functions

    d. Keep alert; watch for changes in skip and solid lines and for off lines

    e. Know signals and keep in contact with other crew members

    f. Clean shrouds often

    g. Keep beads dry

    h. Adjust nozzle height and angle as needed

    i. Make changes *gradually*

    j. Paint new lines on top of existing lines

    k. Operate advance-retard switch with short jogs until cycles match

    l. Empty extractors often

    m. Use traffic control devices as needed

    n. Clean nozzles as needed for even flow of paint

    o. Blow out lines and fill with solvent before storing machine

ANSWERS TO TEST

15. a. 6

    b. 3

    c. 10

    d. 2

    e. 5

    f. 11

    g. 1

    h. 4

    i. 7

    j. 9

    k. 8

16. a. 5

    b. 1

    c. 3

    d. 4

    e. 2

17. Answer should include any ten of the following

    a. Wear hard hat and visible vest

    b. Use required traffic control devices

    c. Perform all prestart inspection and maintenance procedures

    d. Be sure paint tank is clean before adding paint

    e. Use a filter screen when pouring paint into tank

    f. Adjust nozzle height and angle according to job

    g. Be sure you know your starting and stopping point before painting

    h. Signal crew before starting

    i. Line up machine for a straight approach

    j. Move at a constant speed

    k. Keep lines straight

    l. Keep gun as close to curb as possible when painting islands or curbs

    m. Do not run wheels over new paint when turning or lining up for next pass

    n. Flush lines and nozzles with solvent several times during the day

ANSWERS TO TEST

   o. Soak nozzle and shroud in solvent when not in use
   p. Make needed adjustments over painted area

18. Evaluated to the satisfaction of the instructor

19. Performance skills evaluated to the satisfaction of the instructor

PUGMILL
UNIT XV

UNIT OBJECTIVE

After completing this unit, the student should be able to operate a pugmill safely and effectively. This knowledge will be shown by completing job sheets and unit test with a minimum score of 85 percent.

SPECIFIC OBJECTIVES

After completing this unit, the student should be able to

1. Match terms associated with pugmills to their correct definitions.
2. Select from a list equipment used in a pugmill operation.
3. Identify the parts of a typical pugmill.
4. Match pugmill controls to their correct functions.
5. Arrange in order stages of material flow.
6. Select from a list the pugmill operator's responsibilities.
7. State safety rules for operating a pugmill.
8. State procedures for effective pugmill operation.
9. Select from a list procedures for correcting overload.
10. Demonstrate the ability to
    a. Perform prestart inspection and maintenance procedures on a pugmill.
    b. Service a pugmill.
    c. Start, warm up, and shut down a pugmill.
    d. Operate a pugmill.

PUGMILL
UNIT XV

SUGGESTED ACTIVITIES

I. Suggested activities

   A. Order materials to supplement unit.

      1. Films

         a. *Shake Hands With Danger.* Color, 22 minutes, Calvin Communications, 1980. Available from Calvin Communications, P.O. Box 15607, Kansas City, Missouri 60106, (816) 471-7800.

         (NOTE: This film stresses the importance of safety procedures that if ignored or overlooked will result in serious consequences. It is an excellent film to show heavy equipment operators.)

         b. *Keeping Your Job is Work.* Color, 12 minutes, Dibie-Dash, 1971. Available from Dibie-Dash Productions, Inc., 4949 Hollywood Boulevard, Suite 208, Hollywood, California 90027.

         (NOTE: This film emphasizes the importance of meeting job responsibilities. It is very unique but simple, and presents a series of job situations pointing out the responsibilities of an employee.)

   B. Provide students with objective sheet.

   C. Provide students with information and job sheets.

   D. Discuss unit and specific objectives.

   E. Discuss information sheet.

   F. Demonstrate and discuss procedures outlined in job sheets.

   G. Provide alternative jobs if those in job sheets are not practical.

   H. Point out to students that the use of the term *oil* for *liquid asphalt material* is restricted to this unit and that in general, they should refer to oils and fuels by their descriptive names to avoid misunderstandings.

   I. Arrange a field trip for students to observe a pugmill operation.

   J. Reveiw first-aid treatment for burns.

   K. Discuss asphalt cutback and emulsion materials.

   L. Stress the importance of staying alert when operating a pugmill.

SUGGESTED ACTIVITIES

M. Demonstrate raising and lowering procedures.

N. Give test.

II. Instructional materials

A. Objective sheet

B. Suggested activities

C. Information sheet

D. Job sheets

1. Job Sheet #1--Perform Prestart Inspection and Maintenance Procedures on a Pugmill
2. Job Sheet #2--Service a Pugmill
3. Job Sheet #3--Start, Warm Up, and Shut Down a Pugmill
4. Job Sheet #4--Operate a Pugmill

E. Test

F. Answers to test

III. Unit reference--*Operation and Maintenance.* Yankton, South Dakota: Kolberg Manufacturing Corporation, 1977.

PUGMILL
UNIT XV

INFORMATION SHEET

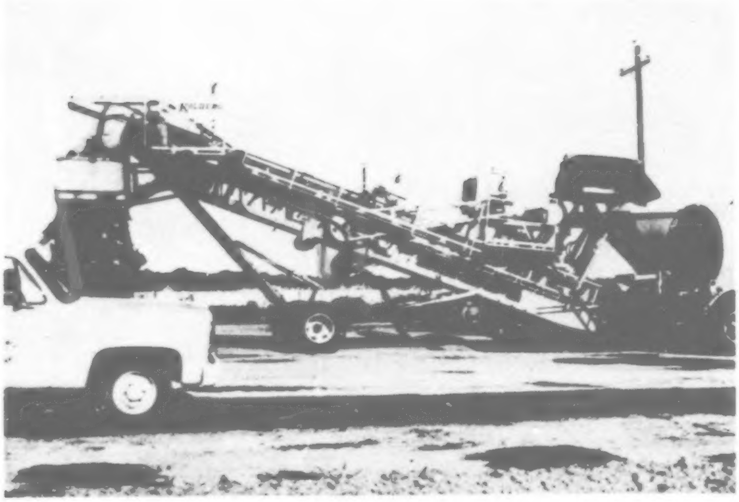
I. Terms and definitions

(NOTE: Unless otherwise specified the term *oil* in this unit refers to liquid asphalt material.)

A. Pugmill--Machine for mixing aggregate and oil (Figure 1)

EXAMPLE: Used for preparing road base or patching materials such as cold mix and coated chips

FIGURE 1



Courtesy of Portec/Kolberg Mfg.

B. Governor--Device for automatic control of speed or pressure

C. Calibrate--To set a standard measure from which corrections can be made

D. Asphalt cement--Asphalt material that is solid at room temperature and must be heated to a liquid state; usable at temperatures of 285°F to 350°F

E. Cutback--Asphalt cement combined with gasoline, kerosene, diesel, or naphtha to form a liquid; usable at temperatures of 145°F to 255°F

(NOTE: Temperatures vary with different liquid asphalts.)

INFORMATION SHEET

EXAMPLES: RC (Rapid Curing) 250, RC 800, RC 3000
MC (Medium Curing) 30, MC 70, MC 250, MC 800, MC 3000
SC (Slow Curing) 70, SC 250, SC 800, SC 3000

(CAUTION: RC cutbacks are highly volatile and must be handled with extreme caution.)

F. Emulsion--Asphalt cement suspended in water; usable at temperatures of 75°F to 130°F

EXAMPLES: (Rapid Setting) RS-1, RS-2 and RS-2K, RS-3K
(Medium Setting) MS-2 and SM-K, CM-K, CMS-1
(Slow Setting) SS-1, SS-1h and SS-K, SS-Kh

II. Equipment used in a pugmill operation

A. Pugmill

B. Front-end loader

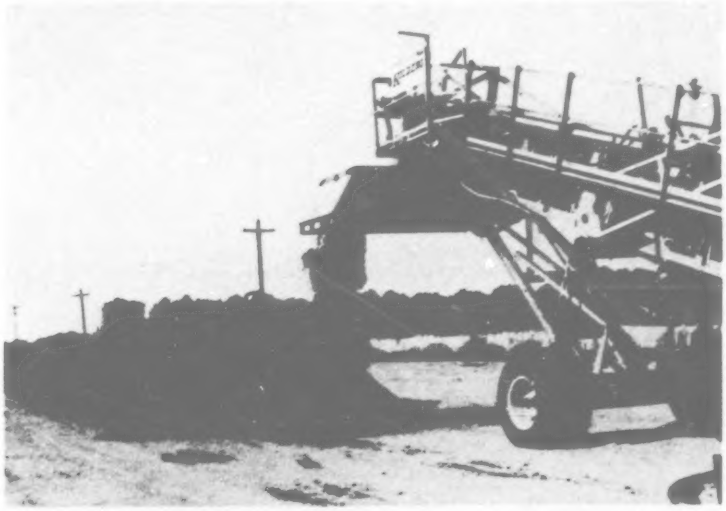
C. Asphalt oil transports

D. Towing vehicle or dump trucks

(NOTE: When stockpiling material [Figure 2], either the pugmill moves and releases material into piles or the pugmill stays in place and material empties into dump trucks [Figure 3]. Dump trucks are also used to deliver material from the pugmill to the job site.)

EXAMPLES:

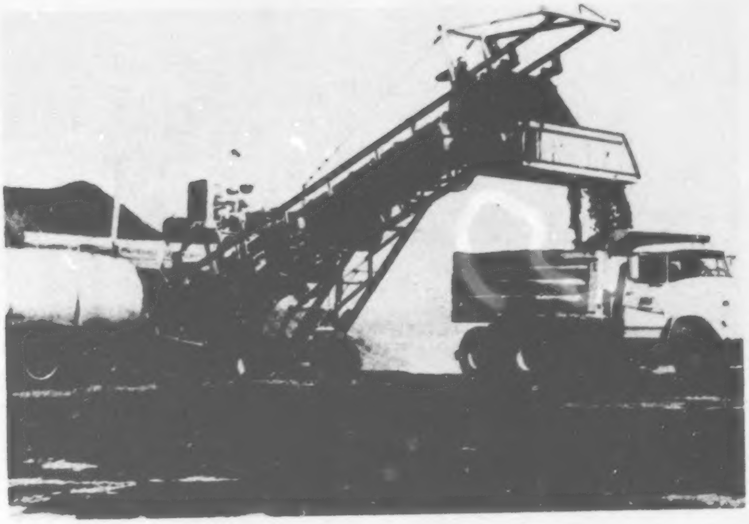
FIGURE 2



Courtesy of Portec/Kolberg Mfg.

INFORMATION SHEET

FIGURE 3



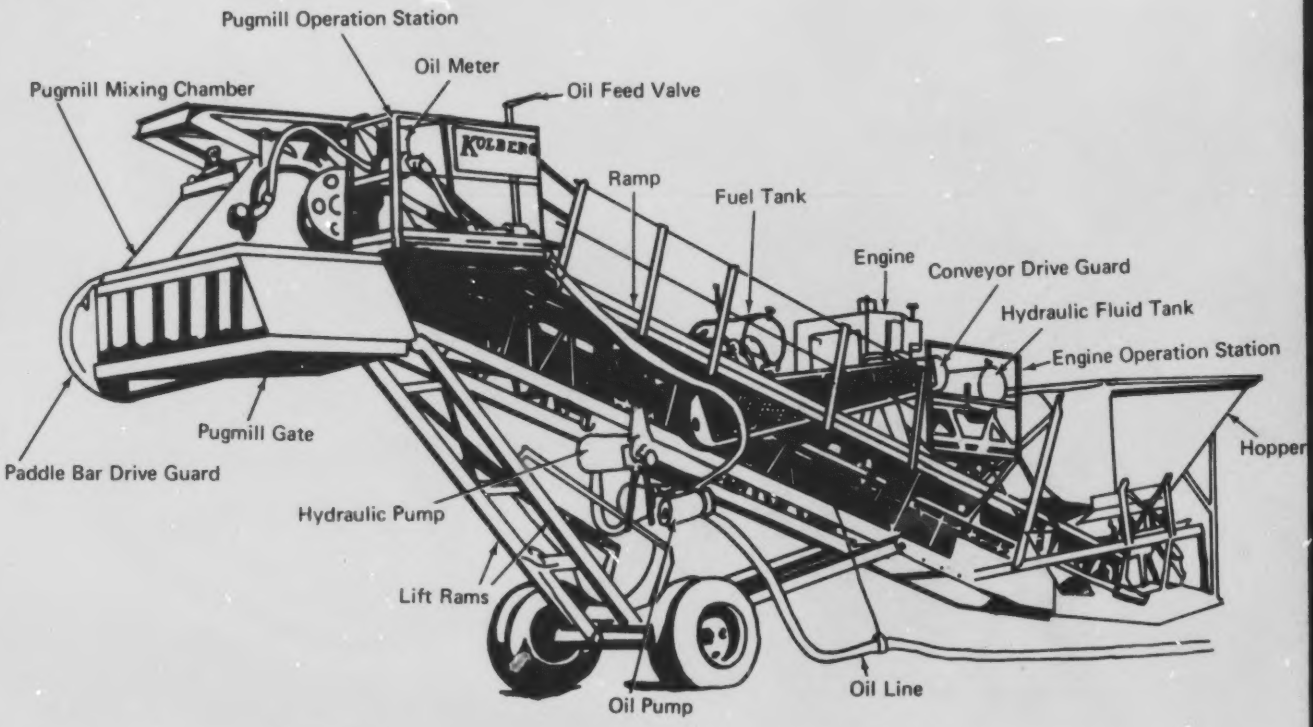
Courtesy of Portec/Kolberg Mfg.

INFORMATION SHEET

III. Parts of a typical pugmill (Figure 4; Job Sheets #1-#4)

(NOTE: Location of components will vary with model and manufacturer.)

FIGURE 4


Pugmill Operation Station
Oil Meter
Pugmill Mixing Chamber
Oil Feed Valve
Kolberg
Ramp
Fuel Tank
Engine
Conveyor Drive Guard
Hydraulic Fluid Tank
Engine Operation Station
Hopper
Pugmill Gate
Paddle Bar Drive Guard
Hydraulic Pump
Lift Rams
Oil Line
Oil Pump

Adapted with permission of Portec/Kolberg Mfg.

INFORMATION SHEET

IV. Pugmill controls and functions (Job Sheets #3 and #4)

(NOTE: Conveyor and paddle speed are automatically controlled by a governor, according to the weight on the conveyor. Oil flow is preset and metered; only minor adjustments are made during operation. Controls will vary with manufacturer and model.)

A. Engine controls

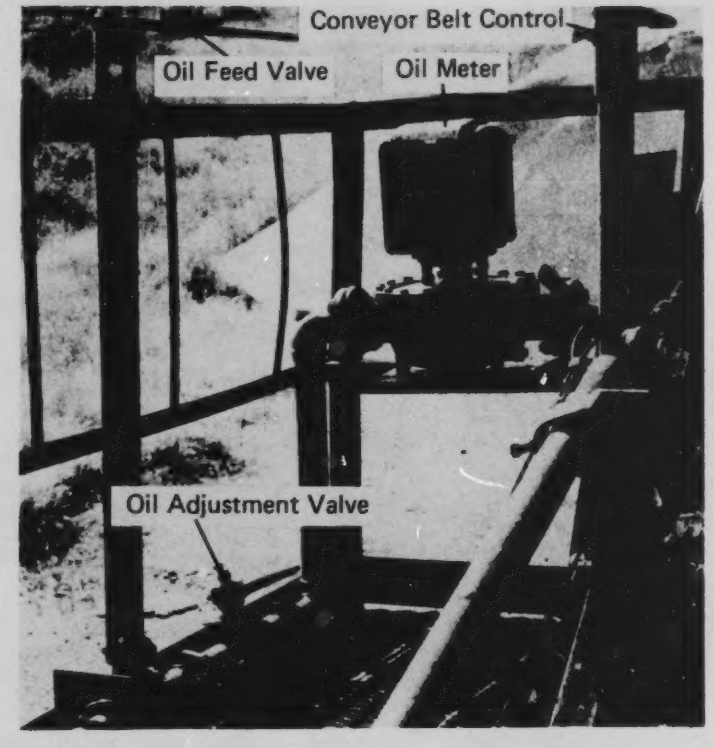
(NOTE: The engine operates a series of drive chains that run the conveyor, the pump, the spray bar, and the paddles.)

1. On/off switch (engine ignition)--Starts and stops engine
2. Choke--Controls air and fuel mixture
3. Start button--Cranks engine
4. Throttle--Sets engine rpm
5. Clutch--Engages drive chains
6. Emergency kill--Shuts off air supply and stops engine

B. Pugmill controls (Figure 5)

EXAMPLE:

FIGURE 5



INFORMATION SHEET

1. Conveyor belt control (head pulley clutch)--Starts or stops conveyor belt and paddles

2. Oil feed valve--Starts or stops flow of oil to spray bar

3. Oil adjustment valve--Increases or decreases amount of oil to spray bar

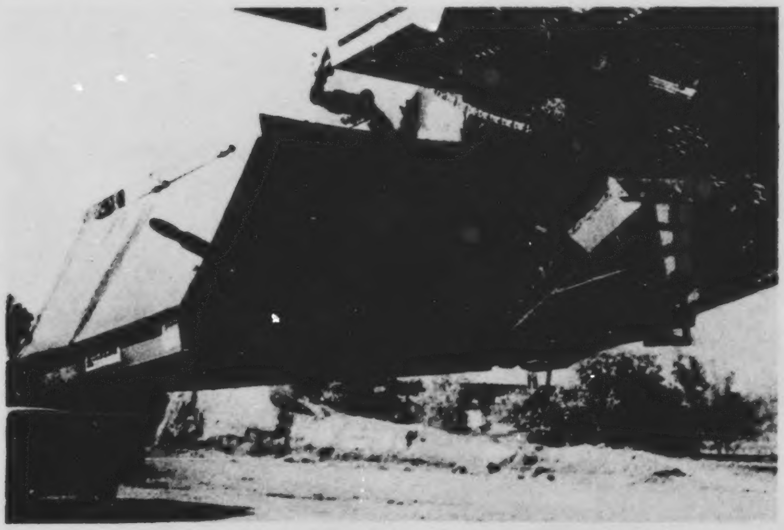
   (NOTE: Only small adjustments can be made with this valve.)

4. Oil meter--Registers amount of oil (in gallons) pumped to pugmill

5. Pugmill gate control--Adjusts gate opening; controls flow of material out of pugmill mixing chamber (Figure 6)

   EXAMPLE:

FIGURE 6



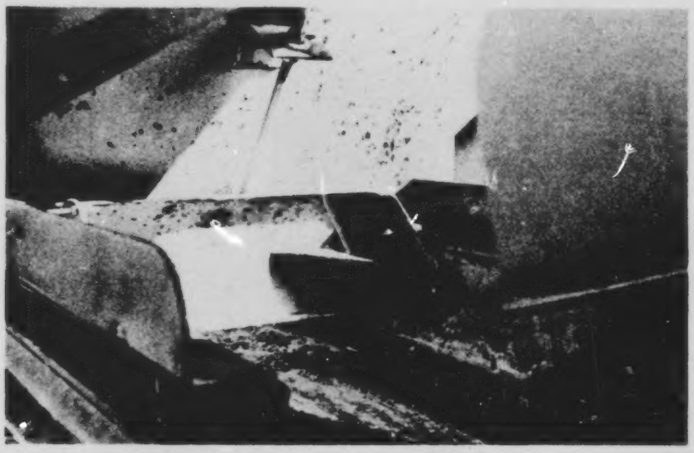
Courtesy of the Kansas Department of Transportation.

INFORMATION SHEET

6. Hopper gate control--Adjusts gate opening; controls flow of mix material to conveyor (Figure 7)

   EXAMPLE:

FIGURE 7



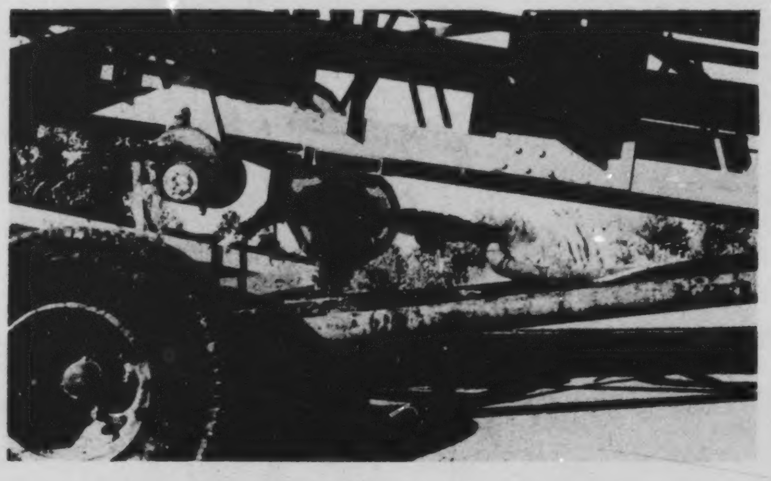
Courtesy of the Kansas Department of Transportation.

C. Undercarriage controls

1. Flow valves--Allow oil to go through pump to pugmill or to recirculate to transport tank (Figure 8)

   EXAMPLE:

FIGURE 8



INFORMATION SHEET

2. Hydraulic valves--Raise or lower unit (Figure 9)

EXAMPLE:

FIGURE 9

V. Stages of material flow

(NOTE: See Section III--Parts of a typical pugmill.)

A. Front-end loader picks up material from stockpile and dumps it into hopper

(NOTE: This operation requires at least a three-yard loader.)

B. Flow gates at bottom of hopper control amount of material loaded onto conveyor belt

C. Conveyor belt moves material from hopper to pugmill mixing chamber

D. Pump moves oil from transport to pugmill

(NOTE: Oil is metered in gallons per minute [gpm] as it passes into the pugmill.)

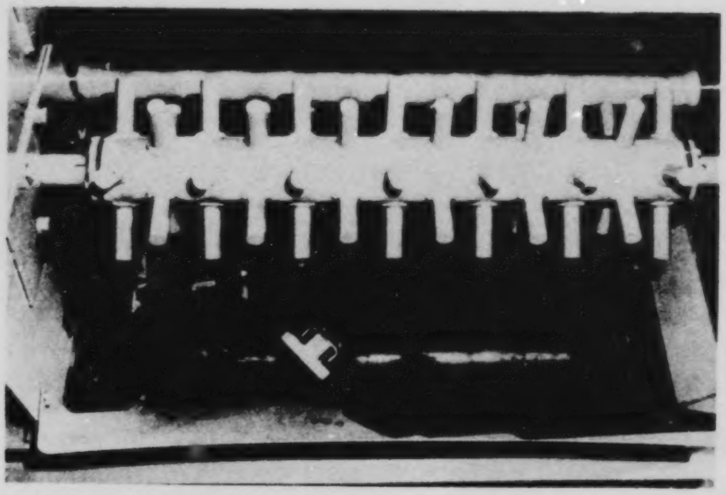
E. Spray bar sprays oil onto material (Figure 10)

INFORMATION SHEET

F. Paddles mix oil and material (Figure 10)

EXAMPLE: Spray bar and paddles

FIGURE 10



Courtesy of Portec/Kolberg Mfg.

G. Material flows through pugmill gates into stockpiles or dump trucks

VI. Pugmill operator's responsibilities (Job Sheets #1-#4)

A. Performs all maintenance

B. Raises and lowers pugmill

C. Operates engine controls

EXAMPLES: Starts engine and pump, keeps engine rpm at proper setting, shuts down engine

D. Watches engine gauges

E. Controls conveyor belt

F. Controls oil flow

G. Watches material flow for constant feed

H. Watches pugmill mixing chamber for proper mix and load level

INFORMATION SHEET

I. Checks oil flow

(NOTE: The operator calculates gallons per minute by timing the meter reading with a stopwatch, and then adjusting the oil flow as needed.)

J. Removes sticks, large rocks, and other debris from conveyor belt

(CAUTION: Do not get fingers or clothing caught in belt.)

VII. Safety rules for operating a pugmill (Job Sheet #4)

(NOTE: The first rule of safety is "safety first.")

A. Read operator's manual thoroughly: know your machine

B. Study departmental safety manual

C. Wear protective clothing

EXAMPLES: Hard-hat, non-skid shoes, gloves (wear insulated gloves when working with hot material), goggles or safety glasses, hearing protection, respirator (fumes can cause nausea)

D. Store fire extinguisher and first-aid kit in accessible place

E. Be sure area is cleared of all personnel before operating

F. Park unit on level ground *at all times*

(NOTE: A pugmill is top heavy and can *easily* tip over.)

G. Keep handrails clean

H. Be sure handrails are in good condition

I. Mount and dismount using both hands on handrails

J. Make sure that all hose connections are secure

K. Check condition of hoses before operating

L. Watch footing to avoid falls

(NOTE: Metal ramp has sharp points to help prevent slipping.)

M. Avoid burns

(NOTE: Hot asphalt will splash out of pugmill. When using high-temperature asphalt material, metal surfaces will be hot.)

N. Keep away from moving parts as much as possible

O. Be sure that all guards and shields are in place and in good condition

INFORMATION SHEET

P. Know the material you are working with

(NOTE: Emulsions are usually not hot enough to cause burns, but AC material is heated to over 300°F.)

Q. Never smoke on the pugmill

R. Hold on when unit is moved

S. Equalize ram operation when raising or lowering unit

(NOTE: The gate side of the pugmill is heavier than the other side. If lift is not equalized, unit can tip over.)

T. When raising or lowering unit, remove and replace safety locking pins according to operator's manual

U. Clean machine thoroughly before changing type of material

EXAMPLE: Changing from emulsions to cutback material

(NOTE: This does not apply when changing weights of the same type material.)

V. Clean oil off skin with solvent as soon as possible

W. Keep machine clean

VIII. Procedures for effective pugmill operation (Job Sheet #4)

(NOTE: The pugmill operator is a busy person! Pay attention at all times: Watch material and oil flow, and be prepared to make adjustments quickly.)

A. Perform all prestart inspection and maintenance procedures

B. Check oil calibration frequently; adjust as needed

C. Check gauges frequently

D. Check mix frequently

E. Adjust oil and material flow as necessary to keep an even mix

EXAMPLES: When material flow thins, cut down oil; when oil supply runs out, shut down conveyor belt.

F. Adjust gates as necessary to keep material flow at the proper rate for desired mix

G. Operate at manufacturer's recommended rpm

H. Keep pugmill from overloading

INFORMATION SHEET

I. Listen to engine

(NOTE: Engine will lug when pugmill overloads. If the load is not corrected, the engine will shut down automatically.)

J. Check oil transport gauge; control conveyor belts carefully toward end of oil supply to keep an even coating

EXAMPLE: If the pump draws about 79 gallons per minute, a 6,000-gallon transport will take about one hour and twenty minutes to unload. Toward the end of the time, check the gauge. Operate the conveyor with the lever, watching the mix carefully. As the oil delivery thins, cut back the amount of material.

K. Shut down conveyor when oil supply runs out

L. Disengage clutch and lower engine rpm if pugmill is not in operation for short periods

(NOTE: This keeps the engine warm while the operator waits for change of transports or dump trucks.)

IX. Procedures for correcting overload

A. Shut off conveyor

B. Shut off oil

C. Allow pugmill to run empty to clean out excess material

D. Widen pugmill gate opening if pugmill overloads again

(NOTE: Gate opening will depend on the type and condition of material. If the material is heavy or wet, use a wider opening; wet material will build up and clog the paddles. For finer, dry material, use a smaller opening; if the gate is too wide, material will not stockpile properly.)

PUGMILL
UNIT XV

JOB SHEET #1--PERFORM PRESTART INSPECTION AND MAINTENANCE PROCEDURES ON A PUGMILL

I. Equipment and materials

   A. Pugmill

   B. Operator's manual

   C. Engine oil

   D. Engine coolant

   E. Hydraulic fluid

   F. Fuel

   G. Lubricants

   H. Grease gun

   I. Rags

II. Procedure

(NOTE: Deficiencies should be corrected immediately or reported to the proper authority. Do not operate defective equipment.)

   A. Make a walk-around visual inspection for leaks and broken, worn, or missing parts

   B. Check engine oil level; add or change engine oil if needed

   C. Check engine coolant level; add coolant if needed

   D. Check hydraulic reservior level; add fluid if necessary

   E. Check fuel level; fill tank if necessary

   F. Check battery connections for tightness and corrosion

   G. Check battery electrolyte level; add water if needed

   H. Check air cleaner; remove and clean filter if necessary

   I. Check brakes

   J. Check tires

   K. Clean and lubricate all grease fittings according to operator's manual

JOB SHEET #1

L. Check hydraulic system for leaking lines and connections, bent or kinked lines, and lines rubbing against other parts

M. Check engine drive belts for proper tension

N. Check electrical wire connections and insulation

O. Check guards and shields

P. Check gauges

Q. Check valves for proper functioning

R. Check levers and controls for proper functioning

S. Remove trash

T. Check safety devices

U. Check major components

   1. Check conveyor and pugmill drive belts for proper tension

   2. Check conveyor belt for holes, stretching, proper alignment

   3. Clean built-up material from hopper area

PUGMILL
UNIT XV

JOB SHEET #2--SERVICE A PUGMILL

I. Equipment and materials

   A. Pugmill

   B. Operator's manual

   C. Tool kit

   D. Grease gun

   E. Lubricants

   F. Cleaning solvents

   G. Rags

   H. Water

   I. Engine coolant

   J. Engine oil

   K. Hydraulic fluid

   L. Tire pressure gauge

   M. Fuel

II. Procedure

(NOTE: Follow departmental preventive maintenance program when servicing equipment. Refer to operator's manual for lubrication chart and for servicing specific components and attachments.)

   A. Visually inspect for leaks and broken, worn, or missing parts

   (NOTE: Major repairs and replacements should be reported to the proper authority and completed by a trained mechanic.)

   B. Check engine oil level, filter, lines, and hoses; add or change engine oil if necessary

   C. Check engine coolant level, radiator cap, hose, and radiator; add coolant if needed

   (CAUTION: Do not remove radiator cap if engine is hot. Let engine cool; then open cap slowly to release pressure.)

JOB SHEET #2

D. Clean air filter; replace if necessary

E. Check fuel level, fuel filters, and sediment bowl (where applicable); fill fuel tank if necessary

F. Check battery electrolyte level, battery cables, and connectors; add water or electrolyte if needed

(CAUTION: Keep sparks and fire away from battery.)

G. Check exhaust system for loose connections and holes

H. Check hydraulic fluid level, filters, hoses, lines, and fittings; look for leaks; add fluid if needed

I. Check clutch adjustment; adjust if necessary

J. Check engine drive belts for tension and wear; adjust or replace if necessary

K. Check wiring, insulation, and connections

L. Clean and lubricate all grease fittings according to operator's manual

M. Check condition of tires

N. Check tire pressure; inflate to recommended pressure

O. Check all safety devices; repair if needed

P. Check conveyor belt alignment; adjust if necessary

Q. Adjust chute so that material loads onto center of belt

R. Check condition of conveyor and pugmill drive belts; check for proper tension; adjust if necessary

S. Check alignment of pulleys and rollers (idlers); adjust if necessary

T. Check hydraulic pump

U. Check hydraulic cylinder packing; replace if necessary

PUGMILL
UNIT XV

JOB SHEET #3--START, WARM UP, AND SHUT DOWN A PUGMILL

I. Equipment and materials

  A. Pugmill

  B. Operator's manual

II. Procedure

  A. Read operator's manual thoroughly

  B. Perform all prestart inspection and maintenance procedures

  C. Mount pugmill carefully, using both hands on handrails

  D. Turn engine ignition to ON

  E. Pull choke out if pugmill is so equipped

  F. Press starter button; release as soon as engine starts

  (CAUTION: Check operator's manual for proper starting procedure.)

  G. Push choke in slowly if pugmill is so equipped

  H. Set throttle to recommended rpm, according to operator's manual

  I. Let engine warm up

  J. Set hopper gate opening

  K. Set pugmill gate opening

  L. Practice moving between engine operation station and pugmill operation station

  M. Locate and identify all controls

  N. Close throttle

  O. Switch engine ignition to OFF

  (NOTE: Under normal operation, you would disengage the clutch, reduce the throttle, and let engine run for three to five minutes to cool down. This lets all parts cool at the same rate.)

  P. Dismount properly

PUGMILL
UNIT XV

JOB SHEET #4--OPERATE A PUGMILL

I. Equipment, materials, and personnel

   A. Pugmill

   B. Operator's manual

   C. Recommended safety equipment

      1. Hard hat

      2. Gloves

      3. Goggles

      4. Non-skid shoes

      5. Respirator

      6. Hearing protection

   D. Front-end loader

   E. Towing vehicle or dump trucks

   F. Aggregate material

   G. Oil transport

   H. Liquid asphalt material (oil)

   I. Engineer's specifications

   J. Stopwatch

   K. Diesel or solvent

   L. Personnel

      1. Loader operator

      2. Towing vehicle operator or dump truck operator

      3. Helper

      4. Oil transport operator

II. Procedure

   A. Perform all prestart inspection and maintenance procedures

JOB SHEET #4

B. Start and warm up engine

C. Set gate openings for size and condition of aggregate

D. Be sure oil flow is adjusted for job specifications

(NOTE: Your supervisor will calibrate flow and set valves.)

E. Make sure oil line is securely connected

(NOTE: Find out oil flow rate, determine when oil supply will run out, and note time.)

F. Signal loader operator when machine is ready for operation

G. Be sure that dump truck is in place or towing vehicle operator is ready for stockpiling

H. Engage clutch

I. Go to pugmill operating station

J. Start conveyor belt

K. Turn on oil as material reaches pugmill mixing chamber

L. Watch mixing

(CAUTION: Material may splash out of mixing chamber.)

M. Adjust gates as needed for proper mix

(NOTE: If pugmill overloads, shut off belt and oil and run pugmill until it empties and is cleaned out. You may have to close the hopper flow gate or open the pugmill gate farther. If mix is too thin, increase hopper flow gate opening.)

N. Check oil calibration

1. Note meter reading and start stopwatch

   (NOTE: The easiest way is to start the stopwatch when the meter is at an even hundred.)

2. Read meter after one minute

   (NOTE: The number of gallons per minute should be very close to the engineer's specifications.)

O. Adjust oil flow as needed

P. Watch material for even flow; remove any foreign objects by hand

(CAUTION: Keep fingers and clothing away from belt.)

JOB SHEET #4

Q. Start and stop material and oil as needed during operation

EXAMPLES: When trucks change, when loading is slow, when transports change

(NOTE: Keep pugmill running when stockpiling.)

R. Check gauges frequently

(NOTE: Be sure engine is running at required rpm and does not overheat.)

S. Check oil transport gauge; as tank nears empty, operate belt manually to keep mix even

(NOTE: When oil supply runs out, shut down belt and close oil flow valve.)

T. At end of operation, run last of material through pugmill; shut off belt and oil

U. Disengage clutch at engine

V. Disconnect oil line

W. Connect diesel or solvent line

X. Open pugmill gate all the way

Y. Engage clutch

Z. Open oil flow valve at pugmill

AA. Run diesel or solvent through pump, lines, and spray bar until paddles are clean

(CAUTION: Solvent may splash out of mixing chamber.)

BB. Shut off oil flow valve

CC. Disengage clutch

DD. Reduce throttle to idle

EE. Let engine run for three to five minutes to cool

FF. Shut down engine

(NOTE: All controls and valves should be in the OFF position.)

GG. Disconnect diesel or solvent line

HH. Dismount properly

II. Make a final walk-around inspection for broken, loose, worn, or missing parts; report any deficiencies to proper authority in writing

DOT II - 837

PUGMILL
UNIT XV

TEST

NAME ________________________________ SCORE ______________

1. Match terms associated with pugmills to their correct definitions. Write the correct numbers in the blanks.

______ a. Asphalt material that is solid at room temperature and must be heated to a liquid state; usable at temperatures of 285°F to 350°F

______ b. Device for automatic control of speed or pressure

______ c. Asphalt cement suspended in water; usable at temperatures of 75°F to 130°F

______ d. To set a standard measure from which corrections can be made

______ e. Machine for mixing aggregate and oil

______ f. Asphalt cement combined with gasoline, kerosene, diesel, or naphtha to form a liquid; usable at temperatures of 145°F to 255°F

1. Governor
2. Asphalt cement
3. Pugmill
4. Cutback
5. Emulsion
6. Calibrate

2. Select from the following list equipment used in a pugmill operation. Write an "X" in the blank before each correct answer.

______ a. Pugmill

______ b. Windmill

______ c. Crane

______ d. Towing vehicle or dump trucks

______ e. Asphalt oil transports

______ f. Shovels

______ g. Front-end loader

______ h. Pickup trucks

______ i. Motor grader

TEST

3. Identify the parts of a typical pugmill. Write the correct numbers in the blanks.

______a. Hydraulic fluid tank

______b. Oil feed valve

______c. Hopper

______d. Paddle bar drive guard

______e. Oil line

______f. Fuel tank

______g. Pugmill operation station

______h. Conveyor drive guard

______i. Engine operation station

______j. Ramp

______k. Pugmill gate

______l. Lift rams

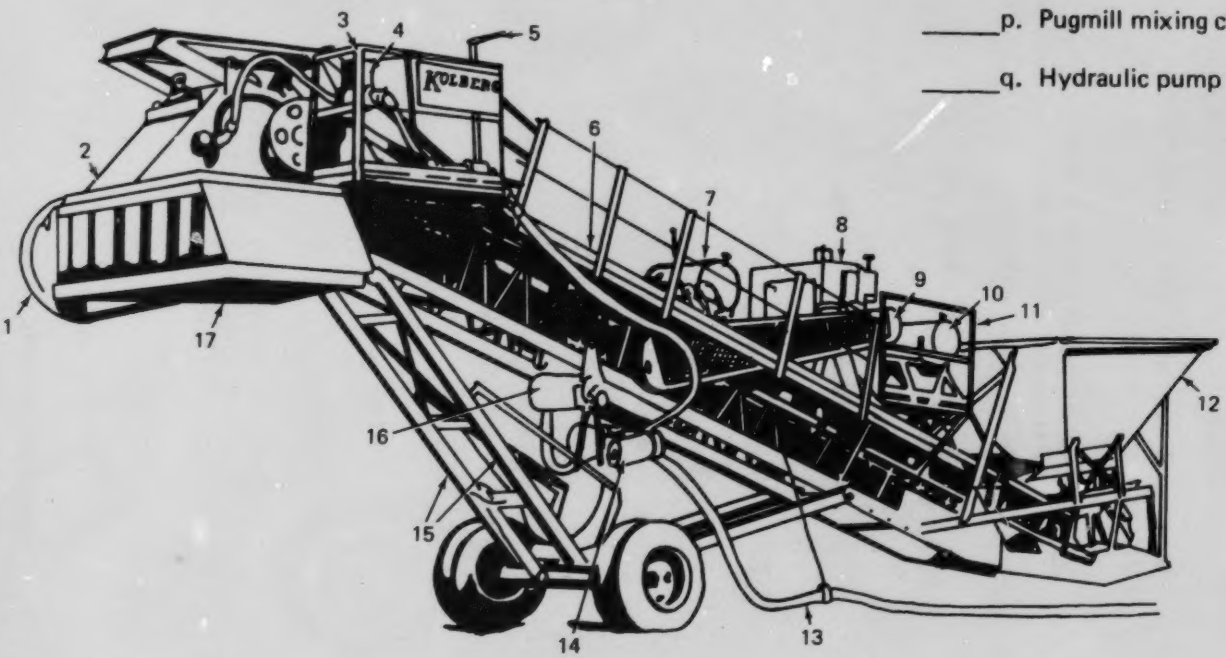
______m. Oil meter

______n. Engine

______o. Oil pump

______p. Pugmill mixing chamber

______q. Hydraulic pump



TEST

4. Match pugmill controls to their correct functions. Write the correct numbers in the blanks.

Engine controls

_____a. Cranks engine

_____b. Shuts off air supply and stops engine

_____c. Sets engine rpm

_____d. Controls air and fuel mixture

_____e. Starts and stops engine

_____f. Engages drive chains

1. Throttle
2. Clutch
3. On/off switch (engine ignition)
4. Emergency kill
5. Start button
6. Choke

Pugmill controls

_____a. Starts or stops flow of oil to spray bar

_____b. Adjusts gate opening; controls flow of material out of pugmill mixing chamber

_____c. Registers amount of oil (in gallons) pumped to pugmill

_____d. Starts or stops conveyor belt and paddles

_____e. Adjusts gate opening; controls flow of mix material to conveyor

_____f. Increases or decreases amount of oil to spray bar

1. Oil feed valve
2. Conveyor belt control (head pulley clutch)
3. Hopper gate control
4. Oil meter
5. Oil adjustment valve
6. Pugmill gate control

Undercarriage controls

_____a. Raise or lower unit

_____b. Allow oil to go through pump to pugmill or to recirculate to transport tank

1. Flow valves
2. Hydraulic valves

5. Arrange in order stages of material flow. Write a "1" before the first stage, a "2" before the second stage, and so on.

_____a. Paddles mix oil and material

_____b. Conveyor belt moves material from hopper to pugmill mixing chamber

_____c. Front-end loader picks up material from stockpile and dumps it into hopper

TEST

______d. Material flows through pugmill gates into stockpiles or dump trucks

______e. Flow gates at bottom of hopper control amount of material loaded onto conveyor belt

______f. Pump moves oil from transport to pugmill

______g. Spray bar sprays oil onto material

6. Select from the following list the pugmill operator's responsibilities. Write an "X" in the blank before each correct answer.

______a. Checks oil flow

______b. Performs all maintenance

______c. Services towing vehicle

______d. Inspects other employees' work while pugmill is in operation

______e. Watches material flow for constant speed

______f. Watches engine gauges

______g. Reads a book while pugmill is in operation

______h. Operates dump truck

______i. Controls conveyor belt

______j. Removes sticks, large rocks, and other debris from conveyor belt

______k. Controls speed of conveyor belt

______l. Operates engine controls

______m. Operates front-end loader

______n. Controls oil flow

______o. Operates tow vehicle

______p. Raises and lowers pugmill

______q. Hooks and unhooks oil line

______r. Watches pugmill mixing chamber for proper mix and load level

______s. Adjusts amount of aggregate fed into hopper

______t. Races other equipment to job site

TEST

7. State fifteen safety rules for operating a pugmill.

a. ______________________________

b. ______________________________

c. ______________________________

d. ______________________________

e. ______________________________

f. ______________________________

g. ______________________________

h. ______________________________

i. ______________________________

j. ______________________________

k. ______________________________

l. ______________________________

m. ______________________________

n. ______________________________

o. ______________________________

8. State seven procedures for effective pugmill operation.

a. ______________________________

b. ______________________________

c. ______________________________

d. ______________________________

e. ______________________________

f. ______________________________

g. ______________________________

TEST

9. Select from the following list procedures for correcting overload. Write an "X" in the blank before each correct answer.

______a. Check oil calibration; adjust as needed

______b. Shut off oil

______c. Shut off conveyor

______d. Shut off hydraulic pump

______e. Allow pugmill to run empty to clean out excess material

______f. Increase oil flow

______g. Adjust hopper gate opening to decrease material flow

______h. Slow conveyor down

______i. Widen pugmill gate opening if pugmill overloads again

(NOTE: Test question 10 lists the job sheets. They are an important part of this test. If they have not been completed, check with your instructor.)

10. Demonstrate the ability to

a. Perform prestart inspection and maintenance procedures on a pugmill.

b. Service a pugmill.

c. Start, warm up, and shut down a pugmill.

d. Operate a pugmill.

PUGMILL
UNIT XV

ANSWERS TO TEST

1. a. 2
   b. 1
   c. 5
   d. 6
   e. 3
   f. 4

2. a, d, e, g

3. a. 10
   b. 5
   c. 12
   d. 1
   e. 13
   f. 7
   g. 3
   h. 9
   i. 11
   j. 6
   k. 17
   l. 15
   m. 4
   n. 8
   o. 14
   p. 2
   q. 16

4. **Engine controls**

   a. 5
   b. 4
   c. 1
   d. 6
   e. 3
   f. 2

   Pugmill controls

   a. 1
   b. 6
   c. 4
   d. 2
   e. 3
   f. 5

   Undercarriage controls

   a. 2
   b. 1

ANSWERS TO TEST

5. a. 6
   b. 3
   c. 1
   d. 7
   e. 2
   f. 4
   g. 5

6. a, b, e, f, i, j, l, n, p, r

7. Answer should include any fifteen of the following
   a. Read operator's manual thoroughly: know your machine
   b. Study departmental safety manual
   c. Wear protective clothing
   d. Store fire extinguisher and first-aid kit in accessible place
   e. Be sure area is cleared of all personnel before operating
   f. Park unit on level ground *at all times*
   g. Keep handrails clean
   h. Be sure handrails are in good condition
   i. Mount and dismount using both hands on handrails
   j. Make sure that all hose connections are secure
   k. Check condition of hoses before operating
   l. Watch footing to avoid falls
   m. Avoid burns
   n. Keep away from moving parts as much as possible
   o. Be sure that all guards and shields are in place and in good condition
   p. Know the material you are working with
   q. Never smoke on the pugmill
   r. Hold on when unit is moved
   s. Equalize ram operation when raising or lowering unit
   t. When raising or lowering unit, remove and replace safety locking pins according to operator's manual

ANSWERS TO TEST

u. Clean machine thoroughly before changing type of material

v. Clean oil off skin with solvent as soon as possible

w. Keep machine clean

8. Answer should include any seven of the following

   a. Perform all prestart inspection and maintenance procedures

   b. Check oil calibration frequently; adjust as needed

   c. Check gauges frequently

   d. Check mix frequently

   e. Adjust oil and material flow as necessary to keep an even mix

   f. Adjust gates as necessary to keep material flow at the proper rate for desired mix

   g. Operate at manufacturer's recommended rpm

   h. Keep pugmill from overloading

   i. Listen to engine

   j. Check oil transport gauge; control conveyor belts carefully toward end of oil supply to keep an even coating

   k. Shut down conveyor when oil supply runs out

   l. Disengage clutch and lower engine rpm if pugmill is not in operation for short periods

9. b, c, e, i

10. Performance skills evaluated to the satisfaction of the instructor

VACUUM SWEEPERS
UNIT XVI

UNIT OBJECTIVE

After completing this unit, the student should be able to safely and effectively operate a vacuum sweeper. This knowledge will be shown by completing the job sheets and unit test with a minimum score of 85 percent.

SPECIFIC OBJECTIVES

After completing this unit, the student should be able to

1. Match terms associated with vacuum sweepers to their correct definitions.
2. Identify parts of a vacuum sweeper.
3. Identify controls on a typical vacuum sweeper.
4. State safety rules for operating a vacuum sweeper.
5. Arrange in order functions of a vacuum sweeper.
6. State procedures for an effective sweeping operation.
7. Demonstrate the ability to
    a. Perform prestart inspection and maintenance procedures on a vacuum sweeper.
    b. Service a vacuum sweeper.
    c. Perform prestart procedures, warm up, start, operate, and shut down a vacuum sweeper.
    d. Dump material from full vacuum sweeper.
    e. Clean and store sweeper.
    f. Sweep a two-way traffic roadway.
    g. Sweep a divided roadway.

VACUUM SWEEPERS
UNIT XVI

SUGGESTED ACTIVITIES

I. Suggested activities

- A. Order operator's manuals for equipment to be used.
- B. Provide students with objective sheet.
- C. Provide students with information and job sheets.
- D. Discuss unit and specific objectives.
- E. Discuss information sheet.
- F. Demonstrate and discuss procedures outlined in job sheets.
- G. Provide alternate jobs if those in job sheets are not practical.
- H. Have students practice using vacuum sweeper controls until they become proficient.
- I. Review traffic control devices.
- J. Give test.

II. Instructional materials

- A. Objective sheet
- B. Suggested activities
- C. Information sheet
- D. Job sheets
    1. Job Sheet #1--Perform Prestart Inspection and Maintenance Procedures on a Vacuum Sweeper
    2. Job Sheet #2--Service a Vacuum Sweeper
    3. Job Sheet #3--Perform Prestart Procedures, Warm Up, Start, Operate, and Shut Down a Vacuum Sweeper
    4. Job Sheet #4--Dump Material from Full Vacuum Sweeper
    5. Job Sheet #5--Clean and Store Sweeper
    6. Job Sheet #6--Sweep a Two-Way Traffic Roadway
    7. Job Sheet #7--Sweep a Divided Roadway

SUGGESTED ACTIVITIES

E. Test

F. Answers to test

III. Unit references

A. *Operation and Maintenance Manual, Vac-All.* Central Engineering Co., Inc., Milwaukee, Wisconsin, 1980.

B. *Operation, Service and Parts Manual, M-B Cruiser Sweeper.* M-B Company, New Holstein, Wisconsin, n.d.

VACUUM SWEEPERS
UNIT XVI

INFORMATION SHEET

I. Terms and definitions

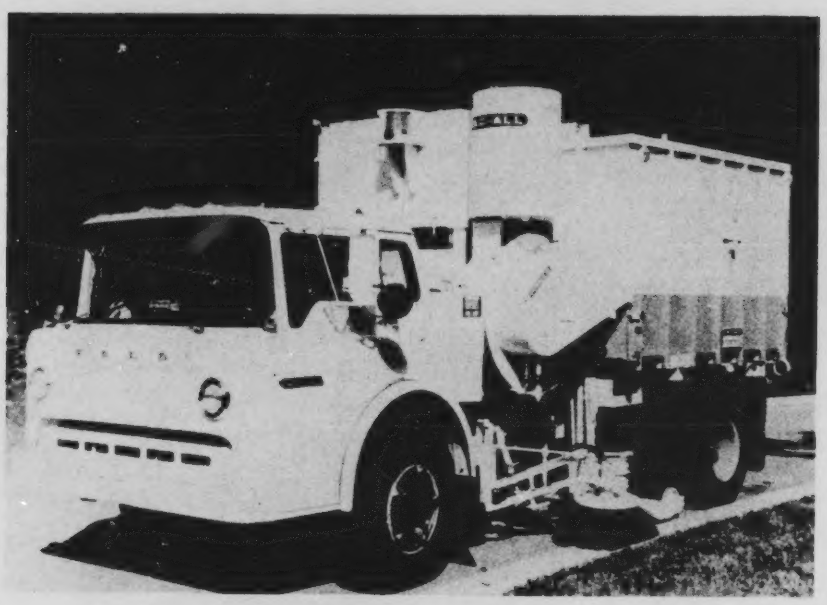
A. Vacuum sweeper--Power suction broom used to clean dirt, dust, and debris from roadways

EXAMPLES: Intersections on rural roads, bridge decks, highway on-ramps and off-ramps, state highways, throughways, intersections in small communities

(NOTE: Sweepers may have three or more brooms; their location will vary with different models.)

EXAMPLE:

FIGURE 1



Courtesy of Central Engineering Company, Inc., Milwaukee, Wisconsin.

B. Velocity--Speed

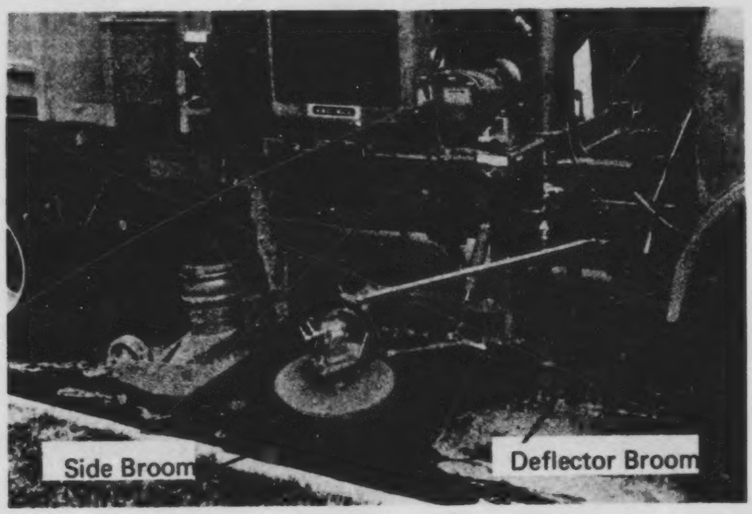
C. Gutter or side broom--Broom mounted on side; pulls dirt and debris away from curb (See Figure 2)

INFORMATION SHEET

D. Pickup or deflector broom--Broom mounted under body; moves dirt and debris toward intake hose (Figure 2)

EXAMPLE:

FIGURE 2



Courtesy of Central Engineering Company, Inc., Milwaukee, Wisconsin.

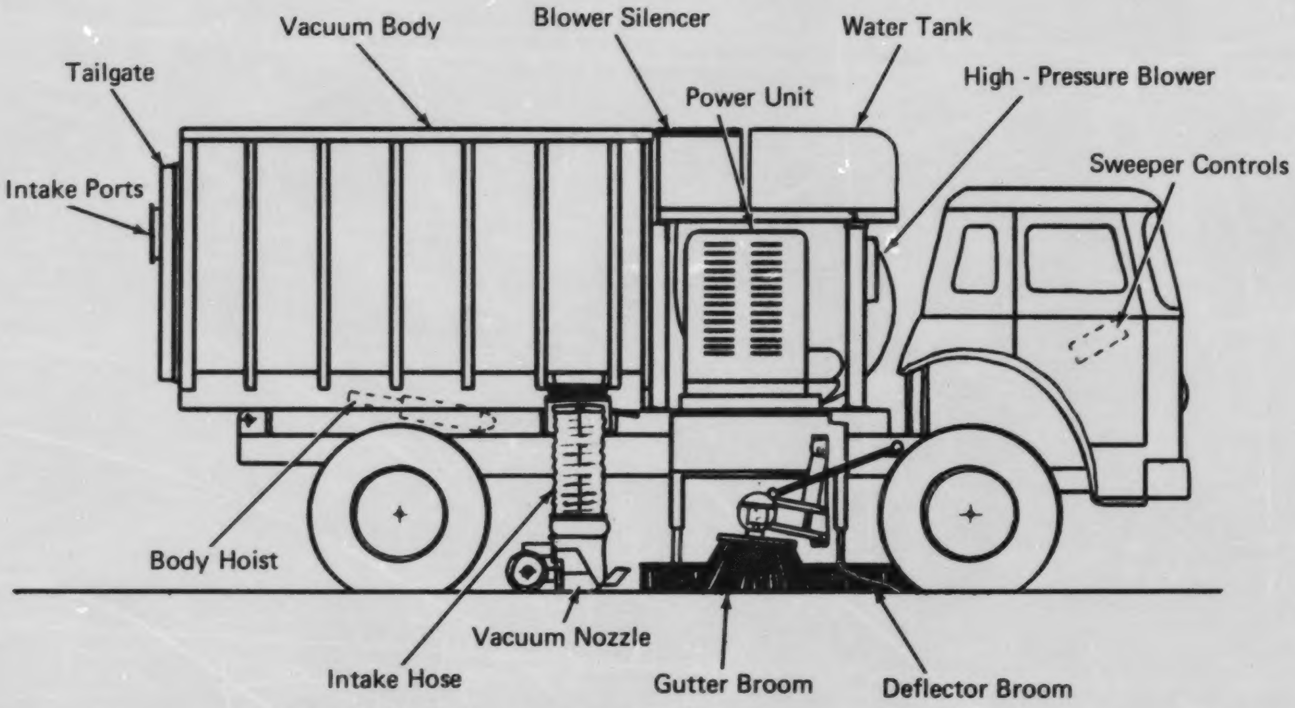
E. Sprinkler system--Water system that wets debris to reduce dust

INFORMATION SHEET

II. Parts of a vacuum sweeper (Figure 3; Job Sheet #1)

(NOTE: The power unit [sweeper engine] drives the exhaust fan, compressed air system, hydraulic and sprinkler system.)

FIGURE 3


Vacuum Body
Blower Silencer
Water Tank
Tailgate
Power Unit
High - Pressure Blower
Intake Ports
Sweeper Controls
Body Hoist
Vacuum Nozzle
Intake Hose
Gutter Broom
Deflector Broom

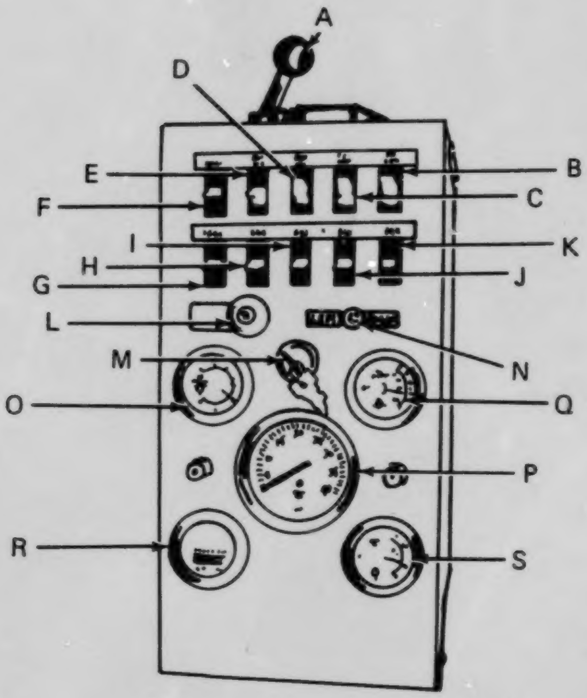
Used with permission of Central Engineering Company, Inc., Milwaukee, Wisconsin.

INFORMATION SHEET

III. Controls on a typical vacuum sweeper (Figure 4)

(NOTE: Controls will vary with model and manufacturer. Brooms can be raised or lowered and moved from side to side by power controls. Most trucks have dual controls and can be driven from either side.)

FIGURE 4



Adapted with permission of Elgin Sweeper Company, Elgin, Illinois.

A. Side-broom pressure regulator--Sets desired amount of down pressure

B. Nozzle control--Lowers nozzle to operating position

C. Side-broom control--Lowers side broom to sweep position; activates rotation and air-compression system

D. Extension-broom control--Lowers extension broom and activates rotation

E. Gate-valve control--Closes suction-hose gate valve to direct suction to opposite side or to catch-basin hose

F. Side-broom light switch--Lights curb area on sweeping side

INFORMATION SHEET

G. Rotary-beacon light switch

H. Nozzle-shutter control (optional)--Opens shutter on nozzle to pick up large pieces such as bricks or rocks

(NOTE: On some models, the nozzle shutter control is a spring-loaded mechanism which opens and closes as it comes in contact with larger debris.)

I. Extension-broom water control--Activates sprinkler system for extension broom

J. Side-broom water control--Activates sprinkler system for side broom

K. Nozzle water control--Activates sprinkler system for nozzle area

(NOTE: Water controls are directly below corresponding broom controls.)

L. Oil pressure indicator light

M. Ignition switch--Starts and shuts down truck engine

N. Dual-control switch--Transfers operation to right or left side of sweeper

O. Air pressure gauge--Indicates air pressure level in system

(NOTE: The air compression system raises and lowers brooms and creates vacuum.)

P. Tachometer--Registers sweeper engine rpm

(NOTE: Set to create proper vacuum power for work conditions.)

Q. Engine-oil pressure gauge--Registers oil pressure in sweeper engine

R. Engine hourmeter--Registers hours of operation for sweeper engine

S. Engine-water temperature gauge--Indicates temperature of water in sweeper engine

(NOTE: The water-pump control valve (not shown) engages the water pump.)

IV. Safety rules for operating a vacuum sweeper

A. Read operator's manual thoroughly: know your machine

B. Study departmental safety manual

C. Wear close-fitting clothing

D. Keep hair, fingers, hands, and feet away from power-driven parts

E. Keep all shields in place

F. Shut down sweeper before making adjustments or repairs

INFORMATION SHEET

G. Keep machine clean

H. When sweeper gets clogged, disconnect all power before cleaning

I. Use all proper traffic control devices

J. Stop gutter-broom rotation before leaving cab

K. Block elevator if you have to enter box to remove caked dirt

V. Functions of a vacuum sweeper (Figure 5)

A. Sprinkler system turns dust to dirt

B. Brooms loosen dirt and debris and throw them toward intake hose

C. Blower exhausts air from body, creating a vacuum inside body

D. Outside air replaces exhausted air at a very high speed through the intake hose

E. Intake hose carries debris into body

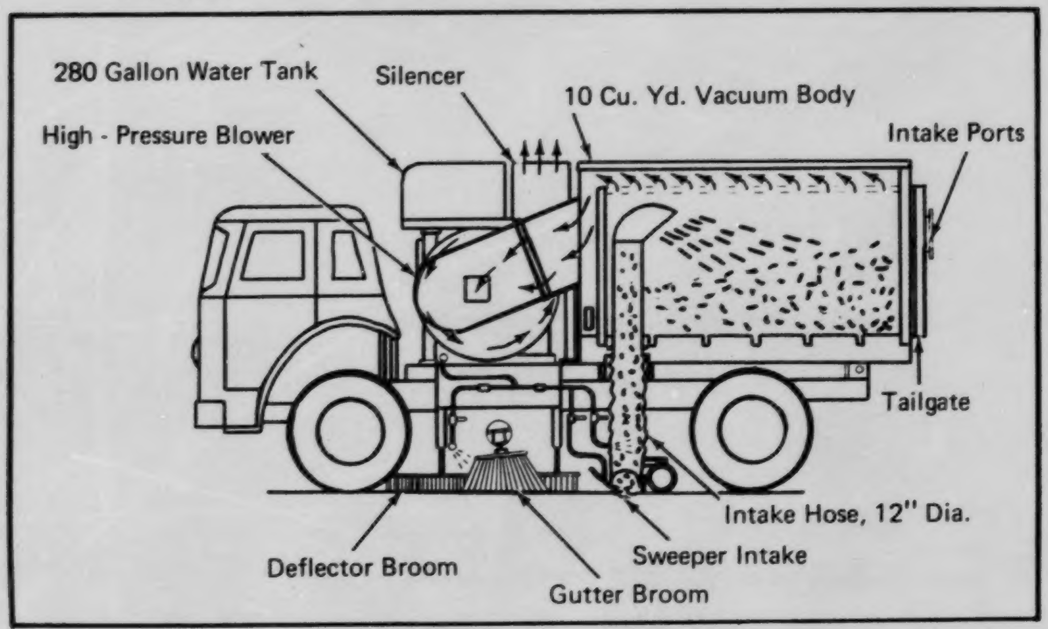
F. Deflector broom shoots debris into bottom of body

G. Air escapes through screens, front air chamber, and blower

EXAMPLE:

AIR FLOW PATTERN

FIGURE 5


280 Gallon Water Tank
Silencer
10 Cu. Yd. Vacuum Body
High - Pressure Blower
Intake Ports
Tailgate
Intake Hose, 12" Dia.
Sweeper Intake
Deflector Broom
Gutter Broom

Used with permission of Central Engineering Company, Inc., Milwaukee, Wisconsin.

INFORMATION SHEET

VI. Procedures for an effective sweeping operation (Job Sheets #2-#7)

A. Perform all prestart inspection and maintenance procedures

B. Sweep from curb to center

C. Sweep with traffic flow

D. Spray water continually to reduce dust

E. Travel slowly, using the correct gear

EXAMPLE:

ENGINE SPEED -- 1600 rpm to 1700 rpm

CONDITION	TRANSMISSION SELECTION	REAR AXLE 2 SPEED BOX	APPROXIMATE TRAVEL SPEED
Extra heavy sweeping	1st	Low	1/2 mph
Heavy sweeping	2nd	Low	1 ½ mph
Moderate to heavy sweeping	3rd	Low	2 ½ mph
Moderate sweeping	1st	High	4 mph
Light sweeping	2nd	High	8 mph
Extra light sweeping	3rd	High	15 mph

Chart used with permission of the M-B Company, Chilton, Wisconsin.

F. Check broom pattern frequently and adjust as needed

G. Make sure only tips of bristles contact surface

(NOTE: Sweep--do not mop. Brooms should operate with a flicking action throwing material into bed with minimum bristle wear. Excessive pressure due to incorrect adjustment forces bristles to bend. This results in a mopping action and early bristle wear with little actual sweeping action.)

H. Avoid jamming gutter broom into curb

I. Use hand throttle for controlling sweeper engine rpm while sweeping

(NOTE: It is *very important* to maintain correct engine speed during sweeping. Low engine rpm will result in poor sweeping, and if engine rpm is too high, pumps will shut down.)

INFORMATION SHEET

J. Use curb-side seat and controls

EXAMPLE: If sweeping the left curb on a divided highway, sit in the left seat.

K. Raise nozzle to pick up items more than one inch high

EXAMPLES: Cans, bottles, bricks

L. Dump when body is full

(NOTE: Vacuum will not pick up when the body is full. Operating the sweeper when the body is full wastes time and money.)

M. Clean sweeper thoroughly after each day's work

N. If freezing temperatures are expected, drain water from entire system

O. Grease often (about every four hours) under dusty conditions

P. Clean air filter often (about every four hours)

Q. Use correct engine speed for working conditions

EXAMPLES: Use lower engine speed for leaves and light trash; use full throttle for heavy sand or dirt.

(NOTE: As a general rule, the lighter the material, the less air is needed. Too much vacuum pressure, particularly when picking up leaves, can clog the system and may damage the road surface.)

VACUUM SWEEPERS
UNIT XVI

JOB SHEET #1--PERFORM PRESTART INSPECTION AND MAINTENANCE PROCEDURES ON A VACUUM SWEEPER

I. Equipment and materials

- A. Vacuum sweeper
- B. Operator's manual
- C. Engine oil
- D. Engine coolant
- E. Hydraulic fluid
- F. Fuel
- G. Lubricants
- H. Grease gun
- I. Rags

II. Procedure

(NOTE: Deficiencies should be corrected immediately or reported to the proper authority. Do not operate defective equipment.)

- A. Make a walk-around visual inspection for leaks and broken, worn, or missing parts
- B. Check engine oil level; add oil if needed
- C. Check engine coolant level; add coolant if needed
- D. Check hydraulic reservoir level; add fluid if needed
- E. Check fuel level; fill tank if necessary
- F. Check battery connections for tightness and corrosion
- G. Check battery electrolyte level; add water if needed
- H. Clean air cleaner; replace filter if necessary
- I. Check brakes
- J. Check tires

JOB SHEET #1

K. Clean all grease fittings and lubricate according to operator's manual

L. Check hydraulic system for leaking lines and connections, bent or kinked lines, and lines rubbing against other parts

M. Check drive belts for tightness

N. Check electrical wire connections and insulation

O. Clean windshield and mirrors; adjust mirrors

P. Check gauges

Q. Check foot pedals for proper functioning

R. Check levers and controls for proper functioning

S. Remove trash

T. Check lights

U. Check safety devices

V. Check major components

W. Adjust brooms to correct pitch

(NOTE: Check operator's manual for adjustment procedures. When you get to the work site, recheck broom pitch so that it will be properly adjusted for working conditions.)

X. Check sprinkler nozzle

Y. Check deflector broom to be sure it is free

Z. Check air compressor filter bowl; clean filter if necessary

VACUUM SWEEPERS
UNIT XVI

JOB SHEET #2--SERVICE A VACUUM SWEEPER

I. Equipment and materials

A. Vacuum sweeper

B. Operator's manual

C. Tool kit

D. Air supply

E. Grease gun

F. Lubricants

G. Cleaning solvents

H. Rags

I. Water

J. Engine coolant

K. Engine oil

L. Hydraulic fluid

M. Transmission fluid

N. Brake fluid

O. Tire pressure gauge

P. Fuel

II. Procedure

(NOTE: Follow departmental preventive maintenance program when servicing equipment. Refer to operator's manual for lubrication chart and for servicing specific components and attachments.)

A. Visually inspect for leaks and broken, worn, or missing parts

(NOTE: Major repairs and replacements should be reported to the proper authority and completed by a trained mechanic.)

B. Check engine oil level, filter, lines, and hoses; add engine oil if needed

C. Check engine coolant level, radiator cap, hose, and radiator; add coolant if needed

(CAUTION: Do not remove radiator cap unless engine is cool; then, open cap slowly to release pressure.)

JOB SHEET #2

D. Clean air filter; replace if necessary

E. Check fuel level, fuel filters, and sediment bowl (where applicable); fill fuel tank if necessary

F. Check battery electrolyte level, battery cables, and connectors; add water or electrolyte if needed

(CAUTION: Keep sparks and fire away from battery.)

G. Check exhaust system for loose connections and holes

H. Check hydraulic fluid level, filters, hoses, lines, and fittings; look for leaks; add fluid if needed

I. Check transmission fluid level; add fluid if needed

J. Check transmission pressure line filter and breather

K. Check brake adjustment and condition; adjust if necessary

L. Check brake master cylinder fluid level; fill if needed

M. Check clutch adjustment; adjust when needed

N. Check drive belts for tension and wear; adjust or replace if necessary

O. Check wiring, insulation, and connections

P. Clean and lubricate all grease fittings according to operator's manual

Q. Check condition of tires

R. Check tire pressure; inflate to recommended pressure if necessary

S. Check all safety devices; repair if necessary

T. Check windshield and windshield wipers; clean if necessary

U. Check major components and/or accessories

1. Brooms for wear
2. Compressed air system for leakage
3. Fan-housing gaskets for dirt and leakage
4. Strainer in water line
5. Pressure valve at water pump; adjust if necessary
6. Wear shoes on nozzle; replace if necessary

VACUUM SWEEPERS
UNIT XVI

JOB SHEET #3--PERFORM PRESTART PROCEDURES, WARM UP, START, OPERATE, AND SHUT DOWN A VACUUM SWEEPER

I. Equipment and materials

  A. Vacuum sweeper

  B. Water supply and hoses

  C. Operator's manual

II. Prestart procedure

  (NOTE: Check operator's manual for specific procedures for your sweeper.)

  A. Complete inspection and daily service on sweeper

  B. Fill water tank

    1. Flush hydrant
    2. Connect filling hose to hydrant
    3. Open gate valve
    4. Open hydrant
    5. Watch sight tube for correct water level
    6. When tank is almost full, shut off hydrant
    7. Close gate valve

  C. Check that tailgate is down, locked, and secure

  D. Fasten covers on front air chamber

  E. Open sweeper intake hose on side to be used

  F. Block off sweeper intake hose on side *not* to be used

  G. Check broom adjustment if you have not already done so

  H. Check nozzle opening

  I. Start truck engine and allow to warm up

  J. Start sweeper engine and allow to warm up; allow pressure to build

JOB SHEET #3

K. Jog pumps ten times--five seconds on, twenty seconds off

L. Idle system three to five minutes

M. While machine warms up, check drain hole in bottom of blower housing and make sure it is not plugged; clean if necessary

N. Increase engine speed to manufacturer's recommended rpm; slip clutch three or four times and engage

O. Speed up engine to blow off any water on filter screens

P. Idle engine down and disengage clutch

Q. Check that intake tube is securely fastened to tailgate

R. Check air-pressure gauge for correct pressure

S. Raise power-boom arm on intake tube for travel clearance

III. Operating procedure

A. Set rpm according to operator's manual

B. Set selector switch for side to be used

C. Engage clutch and select gear shift range

D. Set manual throttle according to sweeping conditions

E. Drop nozzle

F. Drop broom and deflector

G. Set speed control for broom rotation

H. Turn on water

I. Start sweeping

(NOTE: To pick up anything bigger than one inch, raise nozzle; then drop nozzle back down.)

IV. Shut-down procedure

A. Raise broom and nozzle

B. Shut off water

C. Cut throttle down to idle

JOB SHEET #3

D. Disengage sweeper clutch

E. Shut off sweeper engine

F. Set emergency brake

G. Place all levers in NEUTRAL position

H. Allow engine to idle for two to three minutes

I. Shut off truck engine

VACUUM SWEEPERS
UNIT XVI

JOB SHEET #4--DUMP MATERIAL FROM FULL VACUUM SWEEPER

I. Equipment and tools

- A. Vacuum sweeper, ready to be dumped
- B. Operator's manual
- C. Tools needed for particular equipment
- D. Dump site

II. Procedure

(NOTE: Check operator's manual for procedures for specific sweeper.)

- A. Raise broom and nozzle
- B. Shut off water
- C. Cut throttle down to idle
- D. Shut off overload signal if machine is so equipped
- E. Disengage clutch and shut off sweeper engine
- F. Drive to dump site
- G. Set brake
- H. Release intake tube if necessary
- I. Prepare tailgate for opening according to operator's manual

  (NOTE: Tailgate operation may be manual or hydraulic.)
- J. Release tailgate locking mechanism
- K. Raise tailgate to maximum height
  1. Start truck engine
  2. Engage power take-off
  3. Raise hopper body

     (NOTE: Move hoist lever to lifting position and operate engine at 1000 rpm to 1200 rpm.)

JOB SHEET #4

L. After all material has been dumped, move hoist lever to down position with the power take-off still engaged

M. Disengage power take-off

N. Drive forward to clear dumped load

(CAUTION: Do not move truck with truck body in the raised position.)

O. Secure tailgate

P. Fasten intake tube if unfastened

Q. Release brake

R. Return to sweeping site

VACUUM SWEEPERS
UNIT XVI

JOB SHEET #5--CLEAN AND STORE SWEEPER

I. Equipment and materials

- A. Vacuum sweeper
- B. Operator's manual
- C. Water under pressure (40 lbs.)
- D. Hoses
- E. Prop bars
- F. Lubricant
- G. Grease gun
- H. Rags

II. Procedures

(NOTE: The vacuum sweeper must be cleaned and flushed *daily*. In extreme conditions, sweeper will have to be cleaned during operation. Some models have a high-pressure hose which operates off the sweeper tank and pump. Check operator's manual.)

- A. Start sweeper engine; *do not engage clutch*
- B. Release tailgate locking mechanism
- C. Raise tailgate with power boom
- D. Prop tailgate up according to manufacturer's instructions

  (CAUTION: Be sure tailgate is propped before working in or around body.)
- E. Hose down inside of body

  (NOTE: Be sure to clean inside of rear door.)
- F. Wash filter screens
- G. Wash tailgate
- H. Wash brooms
- I. Wash nozzles

JOB SHEET #5

J. Hose down exterior of sweeper

K. Remove clean-out covers from front air chamber; flush out any accumulated material

L. Drain water from hose on tailgate sump

(NOTE: For winter storage, drain and flush entire system.)

M. After cleaning is completed, engage sweeper clutch and run unit for a short time to remove moisture from interior

N. Idle engine down

O. Disengage clutch and shut off engine

P. Leave tailgate partially open and covers off air chamber

Q. Grease blower bearings and clutch throw-out bearing

VACUUM SWEEPER
UNIT XVI

JOB SHEET #6--SWEEP A TWO-WAY TRAFFIC ROADWAY

I. Equipment and materials

- A. Vacuum sweeper
- B. Operator's manual
- C. Recommended safety equipment
    1. Goggles
    2. Close-fitting clothing
    3. Gloves
    4. Four 4" x 4" x 18" wood blocks

II. Procedure

- A. Make a visual inspection of sweeper unit and correct any minor deficiencies
- B. Make sure water reservoir is full
- C. Climb into cab using safety devices
- D. Sit in left-hand driver's seat
- E. Perform starting procedure
- F. Activate all controls to make sure that they are working

  (NOTE: This includes safety equipment such as warning lights, brakes, and horn.)
- G. Raise brooms and vacuum nozzle to travel height and release the emergency brake
- H. Road sweeper to work site
- I. Observe work area to determine that necessary signs are in place and that there are no obstructions in the area
- J. Position sweeper on right-hand side of road over portion to be swept

  EXAMPLES: Sweeping from center line to right curb or to right edge of road; sweeping next to right-hand curb, one pass only
- K. Secure emergency brake

JOB SHEET #6

L. If sweeper has dual controls, select seat which gives you the clearest view of center line or curb being used as a guide

M. Secure seat belt

N. Open water-pump control valve

O. Lower broom and vacuum nozzle against pavement

(NOTE: Some models are equipped with broom-control valves which must be opened before brooms are lowered.)

P. Open water pressure valve to spray nozzles

Q. Set brooms at proper rpm recommended by the manufacturer for work conditions

R. Put truck in low gear

S. Release emergency brake

T. Move forward, shifting up until recommended gear and speed is reached

U. Continue sweeping until predetermined point is reached

V. Close water pressure valve

W. Close broom-control valves

X. Close water-pump control valve

Y. Raise brooms and vacuum nozzle to travel height

Z. Turn sweeper around and repeat steps J through Y

AA. Continue until planned area is swept

BB. Road sweeper to disposal site

CC. Perform dumping operation

DD. Park sweeper in a safe and fairly level place

EE. Secure emergency brake

FF. Perform shut-down procedures

GG. Release seat belt and dismount properly

HH. Block rear wheels both front and back

II. Make a visual inspection of sweeper; list any leaks, worn or broken parts, or loose bolts or hoses; report them to the proper authorities

VACUUM SWEEPERS
UNIT XVI

JOB SHEET #7--SWEEP A DIVIDED ROADWAY

I. Equipment and materials

   A. Vacuum sweeper

   B. Operator's manual

   C. Recommended safety equipment

      1. Goggles

      2. Close-fitting clothing

      3. Gloves

      4. Four 4" x 4" x 18" wood blocks

II. Procedure

   A. Make a visual inspection of sweeper

   B. Make sure water reservoir is full

   C. Climb into cab using safety devices

   D. Sit in driver's seat

   E. Perform starting procedure

   F. Activate all controls to make sure that they are working

      (NOTE: This includes safety equipment such as warning lights, brakes, and horn.)

   G. Raise brooms and vacuum nozzle to travel height

   H. Release emergency brake

   I. Road sweeper to work site

   J. Observe work area to determine that necessary signs are in place and that there are no obstructions in the area

   K. Position sweeper at determined starting point on roadway, with sweeper headed in direction of traffic flow

      (NOTE: If full width of road is to be swept, start at either the outside or inside of the road and work to the other side. When sweeping the outside, sit in the right-hand operator's chair. When sweeping the inside area, sit in the left-hand operator's chair.)

   L. Secure emergency brake

JOB SHEET #7

M. Take right-hand seat to sweep on outside of road

N. Fasten seat belt

O. Open broom-control valves if machine is so equipped

P. Open water-pump control valve

Q. Lower brooms and vacuum nozzle against pavement

R. Open water pressure valve to spray nozzles

S. Set brooms at proper rpm recommended by manufacturer for work conditions

T. Put truck in low gear

U. Release emergency brake

V. Move forward, shifting up until recommended gear and speed is reached

W. Continue sweeping until end of area to be swept is reached

X. Close water pressure valve

Y. Close broom-control valve

Z. Close water-pump control valve

AA. Raise brooms and vacuum nozzle to travel height

BB. Cross over median at a designated crossing to the opposite direction traffic lanes

CC. Position sweeper on roadway headed in direction of traffic flow

DD. Repeat steps L through CC

EE. Secure emergency brake

FF. Unfasten seat belt and move to left-hand seat to sweep inside section of roadway

GG. Fasten seat belt

HH. Repeat steps O through CC

II. Continue until scheduled area is swept

JJ. Close water pressure valve

KK. Close broom-control valve

JOB SHEET #7

LL. Close water-pump control valve

MM. Raise broom and vacuum nozzle to travel height

NN. Road sweeper to disposal site

OO. Perform dumping operation

PP. Park sweeper in a safe and fairly level place

QQ. Secure emergency brake

RR. Perform shut-down procedures

SS. Release seat belt and dismount properly

TT. Block rear wheels both front and back

UU. Make a visual inspection of the sweeper; list any leaks, worn or broken parts, or loose bolts or hoses; report them to the proper authorities

VACUUM SWEEPERS
UNIT XVI

TEST

NAME ______________________ SCORE ______________

1. Match terms associated with vacuum sweepers to their correct definitions. Write the correct numbers in the blanks.

_____a. Broom mounted under body; moves dirt and debris toward intake hose

_____b. Power suction broom used to clean dirt, dust, and debris from roadways

_____c. Speed

_____d. Broom mounted on side; pulls dirt and debris away from curb

_____e. Water system that wets debris to reduce dust

1. Velocity
2. Sprinkler system
3. Pickup or deflector broom
4. Vacuum sweeper
5. Gutter or side broom

TEST

2. Identify parts of a vacuum sweeper. Write the correct numbers in the blanks.

______a. Deflector broom

______b. Blower silencer

______c. Intake ports

______d. Vacuum nozzle

______e. Sweeper controls

______f. Vacuum body

______g. High-pressure blower

______h. Intake hose

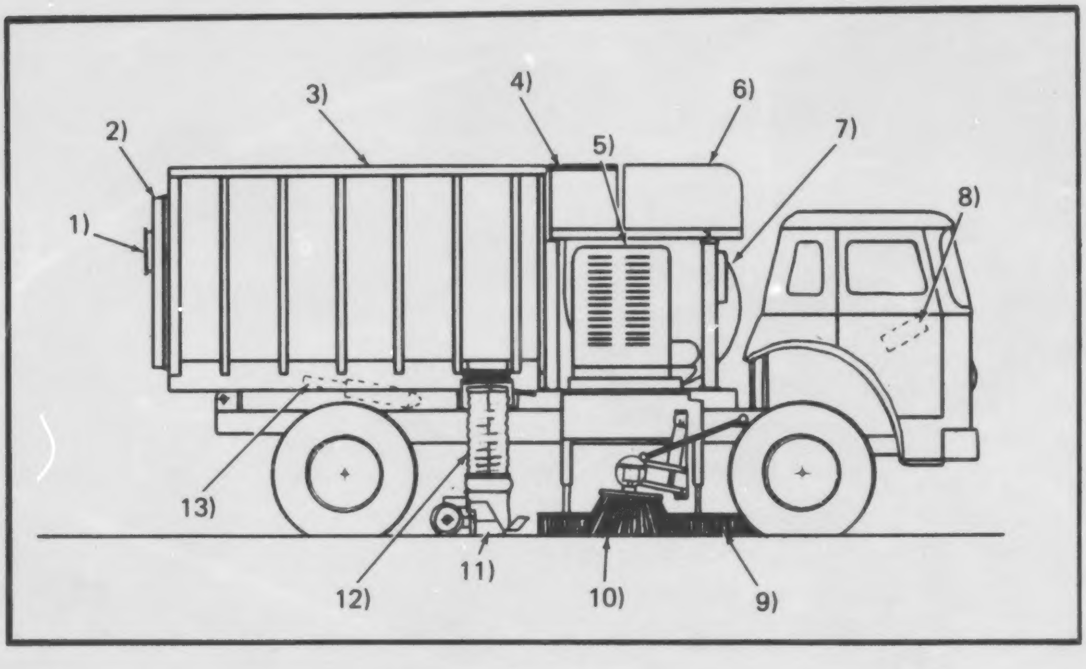
______i. Power unit

______j. Gutter broom

______k. Body hoist

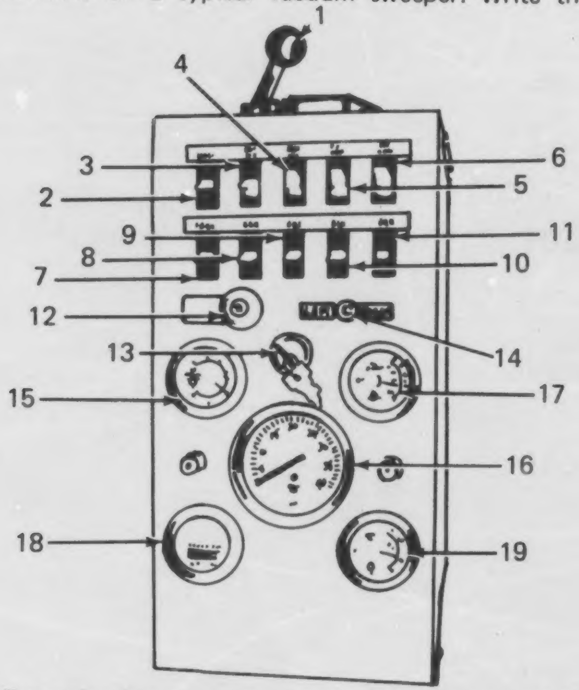
______l. Tailgate

______m. Water tank



TEST

3. Identify controls on a typical vacuum sweeper. Write the correct numbers in the blanks.



______a. Extension-broom water control--Activates sprinkler system for extension broom

______b. Tachometer--Registers sweeper engine rpm

______c. Side-broom light switch--Lights curb area on sweeping side

______d. Nozzle control--Lowers nozzle to operating position

______e. Engine hourmeter--Registers hours of operation for sweeper engine

______f. Oil pressure indicator light

______g. Rotary-beacon light switch

______h. Nozzle-shutter control (optional)--Opens shutter on nozzle to pick up large pieces such as bricks or rocks

______i. Side-broom control--Lowers side broom to sweep position; activates rotation and air-compression system

______j. Air pressure gauge--Indicates air pressure level in system

______k. Dual-control switch--Transfers operation to right or left side of sweeper

______l. Gate-valve control--Closes suction-hose gate valve to direct suction to opposite side or to catch-basin hose

TEST

______m. Nozzle water control--Activates sprinkler system for nozzle area

______n. Ignition switch--Starts and shuts down truck engine

______o. Engine-water temperature gauge--Indicates temperature of water in sweeper engine

______p. Side-broom water control--Activates sprinkler system for side broom

______q. Extension-broom control--Lowers extension broom and activates rotation

______r. Side-broom pressure regulator--Sets desired amount of down pressure

______s. Engine-oil pressure gauge--Registers oil pressure in sweeper engine

4. State seven safety rules for operating a vacuum sweeper.

a. ____

b. ____

c. ____

d. ____

e. ____

f. ____

g. ____

5. Arrange in order functions of a vacuum sweeper. Write a "1" in the blank before the first function, a "2" before the second function, and so on.

______a. Blower exhausts air from body, creating a vacuum inside body

______b. Air escapes through screens, front air chamber, and blower

______c. Sprinkler system turns dust to dirt

______d. Outside air replaces exhausted air at a very high speed through the intake hose

______e. Brooms loosen dirt and debris and throw them toward intake hose

______f. Deflector broom shoots debris into bottom of body

______g. Intake hose carries debris into body

TEST

6. State ten procedures for an effective sweeping operation.

   a. ______________________________

   b. ______________________________

   c. ______________________________

   d. ______________________________

   e. ______________________________

   f. ______________________________

   g. ______________________________

   h. ______________________________

   i. ______________________________

   j. ______________________________

(NOTE: Test question 7 lists the job sheets. They are an important part of this test. If they have not been completed, check with your instructor.)

7. Demonstrate the ability to

   a. Perform prestart inspection and maintenance procedures on a vacuum sweeper.

   b. Service a vacuum sweeper.

   c. Perform prestart procedures, warm up, start, operate, and shut down a vacuum sweeper.

   d. Dump material from full vacuum sweeper.

   e. Clean and store sweeper.

   f. Sweep a two-way traffic roadway.

   g. Sweep a divided roadway.

VACUUM SWEEPERS
UNIT XVI

ANSWERS TO TEST

1. a. 3
   b. 4
   c. 1
   d. 5
   e. 2

2. a. 9
   b. 4
   c. 1
   d. 11
   e. 8
   f. 3
   g. 7
   h. 12
   i. 5
   j. 10
   k. 13
   l. 2
   m. 6

3. a. 9
   b. 16
   c. 2
   d. 6
   e. 18
   f. 12
   g. 7
   h. 8
   i. 5
   j. 15
   k. 14
   l. 3
   m. 11
   n. 13
   o. 19
   p. 10
   q. 4
   r. 1
   s. 17

4. Answer should include any seven of the following
   a. Read operator's manual thoroughly: know your machine
   b. Study departmental safety manual
   c. Wear close-fitting clothing
   d. Keep hair, fingers, hands, and feet away from power-driven parts
   e. Keep all shields in place
   f. Shut down sweeper before making adjustments or repairs
   g. Keep machine clean
   h. When sweeper gets clogged, disconnect all power before cleaning
   i. Use all proper traffic control devices

ANSWERS TO TEST

j. Stop gutter-broom rotation before leaving cab

k. Block elevator if you have to enter box to remove caked dirt

5. a. 3
b. 7
c. 1
d. 4
e. 2
f. 6
g. 5

6. Answer should include any ten of the following

a. Perform all prestart inspection and maintenance procedures

b. Sweep from curb to center

c. Sweep with traffic flow

d. Spray water continually to reduce dust

e. Travel slowly, using the correct gear

f. Check broom pattern frequently and adjust as needed

g. Make sure only tips of bristles contact surface

h. Avoid jamming gutter broom into curb

i. Use hand throttle for controlling sweeper engine rpm while sweeping

j. Use curb-side seat and controls

k. Raise nozzle to pick up items more than one inch high

l. Dump when body is full

m. Clean sweeper thoroughly after each day's work

n. If freezing temperatures are expected, drain water from entire system

o. Grease often (about every four hours) under dusty conditions

p. Clean air filter often (about every four hours)

q. Use correct engine speed for working conditions

7. Performance skills evaluated to the satisfaction of the instructor

CRACK-SEALING EQUIPMENT
UNIT XVII

UNIT OBJECTIVE

After completing this unit, the student should be able to operate a router and crack-sealing machine safely and effectively. This knowledge will be shown by completing the assignment sheet, job sheets, and unit test with a minimum score of 85 percent.

SPECIFIC OBJECTIVES

After completing this unit, the student should be able to

1. Match terms associated with crack-sealing equipment to their correct definitions.
2. Select from a list uses of crack-sealing equipment in highway maintenance.
3. Label crack-sealing equipment.
4. Match types of cracks to their correct descriptions.
5. Arrange in order steps in a crack-sealing operation.
6. Identify parts of a router.
7. Match controls on a typical router to their correct functions.
8. State safety rules for router operation.
9. State rules for effective router operation.
10. Identify parts of a crack-sealing machine.
11. Identify controls and valves on a crack-sealing machine.
12. Match crack-sealing machine controls, valves, and gauges to their correct functions.
13. State safety rules for operating a crack-sealing machine.
14. Select from a list rules for effective crack-sealing machine operation.
15. Discuss safety equipment.
16. Demonstrate the ability to
    a. Perform prestart inspection and maintenance procedures on router.
    b. Service a router.
    c. Start, warm up, operate, and shut down a router.
    d. Rout and blow cracks.

OBJECTIVE SHEET

e. Perform prestart inspection and maintenance procedures on crack-sealing machine.

f. Service a crack-sealing machine.

g. Light burners.

h. Start, warm up and operate crack-sealing machine.

i. Shut down and clean crack-sealing machine.

CRACK-SEALING EQUIPMENT
UNIT XVII

SUGGESTED ACTIVITIES

I. Suggested activities

(NOTE: This unit covers the Crafco crack-sealing machine exclusively. Router material is from Crafco, Inc., but is applicable to other manufacturers.)

A. Order slide/cassette presentations to supplement unit.

1. *Crafco Sealer, BC-220.* 130 slides, Crafco, Inc., 1981. Available from Oklahoma Department of Transportation, Training Office, 200 N.E. 21, Oklahoma City, Oklahoma 73105, 405/521-4141.

(NOTE: Program covers operation and maintenance.)

2. *Crafco Joint and Crack Cleaner, Model 200.* 115 slides, Crafco, Inc., 1981. Available from Oklahoma Department of Transportation, Training Office, 200 N.E. 21, Oklahoma City, Oklahoma 73105, 405/521-4141.

(NOTE: Program covers operation and maintenance.)

B. Make transparencies.

C. Provide students with objective sheet.

D. Provide students with information, assignment, and job sheets.

E. Discuss unit and specific objectives.

F. Discuss information and assignment sheets.

G. Demonstrate and discuss procedures outlined in job sheets.

H. Provide different jobs if those in job sheets are not practical.

I. Arrange for a field trip to watch crack-sealing operations.

J. Review air compressor operation.

K. Explain joint and crack expansion and contraction. Stress that crack sealing is a cold-weather operation.

L. Give test.

(NOTE: You may want to use your blank test to make a test key.)

II. Instructional materials

A. Objective sheet

B. Suggested activities

C. Information sheet

SUGGESTED ACTIVITIES

D. Transparency masters

   1. TM #1--Types of Cracks
   2. TM #2--Asphalt Repairs
   3. TM #3--Concrete Repairs

E. Assignment Sheet #1--Discuss Safety Equipment

F. Answers to assignment sheet

G. Job sheets

   1. Job Sheet #1--Perform Prestart Inspection and Maintenance Procedures on Router
   2. Job Sheet #2--Service a Router
   3. Job Sheet #3--Start, Warm Up, Operate, and Shut Down a Router
   4. Job Sheet #4--Rout and Blow Cracks
   5. Job Sheet #5--Perform Prestart Inspection and Maintenance Procedures on Crack-Sealing Machine
   6. Job Sheet #6--Service a Crack-Sealing Machine
   7. Job Sheet #7--Light Burners
   8. Job Sheet #8--Start, Warm Up, and Operate a Crack-Sealing Machine
   9. Job Sheet #9--Shut Down and Clean Crack-Sealing Machine

H. Test

I. Answers to test

III. Unit references

A. *Instruction Manual and Parts List, Model BC-220 and BC-220-4 Crack Sealing Machine.* Phoenix, Arizona: Crafco, Inc., 1981.

B. *Instruction Manual and Parts List, Model 200 Joint and Crack Cleaner.* Phoenix, Arizona: Crafco, Inc., 1981.

C. *Sealing and Resealing Cracks the Crafco Way.* Phoenix, Arizona: Crafco, Inc., 1979.

CRACK-SEALING EQUIPMENT
UNIT XVII

INFORMATION SHEET

I. Terms and definitions

   A. Crack-sealing machine--Self-contained unit with heater, agitator, material tank, pump, applicator, and cleaning system; used to fill cracks and joints in asphalt and concrete surfaces

   B. Router--Machine used to widen cracks

   C. Blow--To remove dirt and dust with forced air

   D. PCC (portland cement concrete) pavement--Paving mixture usually composed of portland cement, aggregate, and water

   E. Asphalt pavement--Paving mixture composed of crushed rock or other aggregate material cemented with asphalt material

   F. Sealant--Asphalt material applied to cracks and joints to protect against wear and weather and to provide a continuous smooth surface

   G. Solvent--Material that dissolves other materials

   H. Crack--Break in the general continuity of pavement

   I. Longitudinal crack--Break that runs along length of roadway

   J. Transverse crack--Break that runs across width of roadway

   K. Joint--Space between two sections of pavement

   L. Asphalt emulsion--Asphalt material suspended in water; applied at normal temperatures

      EXAMPLES: Slow setting (SS-1) and rapid setting (RS-1)

   M. Asphalt cutback--Asphalt material mixed with light volatile oil; applied at high temperatures

      EXAMPLES: Rapid curing (RC) and medium curing (MC) asphaltic materials

II. Uses of crack-sealing equipment in highway maintenance (Job Sheet #8)

   A. Sealing concrete joints

   B. Sealing concrete cracks

   C. Sealing asphalt cracks

   D. Sealing joints between concrete road and asphalt shoulders

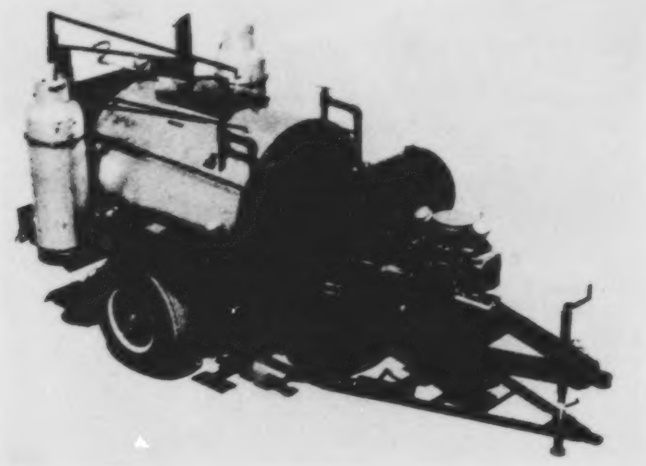
INFORMATION SHEET

III. Crack-sealing equipment (Figures 1-4)

A. Crack-sealing machine

(NOTE: Sealing material [liquid sealant or solid, rubberized asphalt material mixed with oil] is fed into a heated mixing unit. Heat-transfer oil lines pass through the material tank to melt or heat the material, and a rotating auger agitates it. Material is then pumped through a hose to a hand-held applicator.)

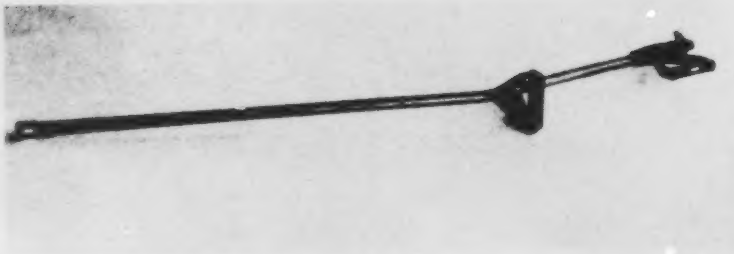
FIGURE 1



Courtesy of Crafco, Inc.

B. Hand applicator

FIGURE 2

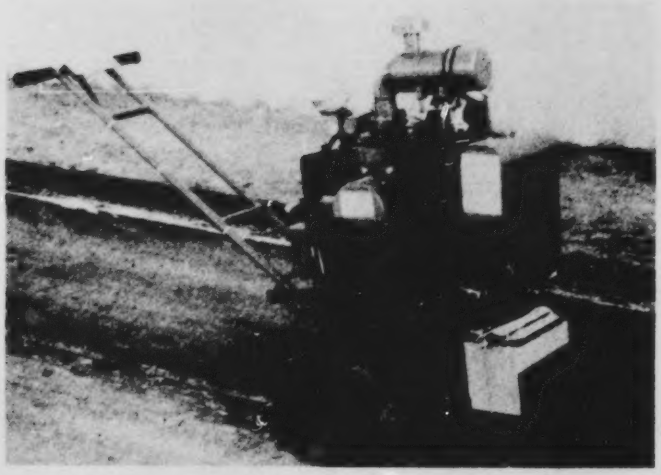


Courtesy of Crafco, Inc.

INFORMATION SHEET

C. Router

FIGURE 3

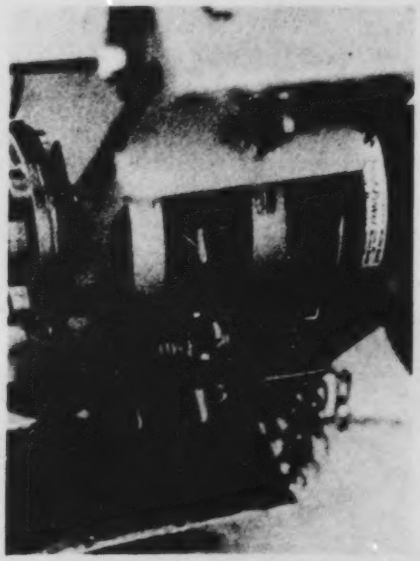


Courtesy of Crafco, Inc.

D. Cutters

(NOTE: Revolving cutters widen the crack for filling. See Figure 4.)

FIGURE 4



Courtesy of Crafco, Inc.

INFORMATION SHEET

IV. Types of cracks (Transparency #1; Job Sheet #4)

(NOTE: Routing procedures will vary with different types of cracks.)

A. Longitudinal and transverse

1. Wedge-shaped at top and closed at bottom; widths vary from hairline to 1"

2. Depressed at surface on each side; widths vary from 1/2" to 2" (asphalt only)

   (NOTE: The size of depressed asphalt cracks is often deceptive because the top of the crack may be pushed together. These cracks may also have secondary cracking.)

B. Fatigue or "alligator"--Spread over the surface in shallow, interconnected patterns; widths vary from hairline to 1/4" (asphalt only)

C. Construction joints--Have essentially parallel sides and usually extend to the subgrade; widths vary from 1/4" to 2"

V. Steps in a crack-sealing operation (Transparencies #2 and #3; Job Sheets #4 and #8)

A. Longitudinal and transverse cracks and construction joints

1. Rout any cracks less than 3/8" to 1/2" wide and 3/4" to 1" deep

   (NOTE: Cracks that are depressed at the surface are an exception and should be routed less than 1/2 inch wide.)

2. Blow cracks with portable blower or air compressor

   (NOTE: Cracks must be free of all dirt and foreign material for proper bonding.)

3. Heat asphalt-sealing material

4. Seal cracks from bottom to top

   (NOTE: A variety of sealing tips is available for sealing different sizes and shapes of cracks. Fill cracks to within 3/8" of surface or according to manufacturer's suggested level. This clearance allows the joints to expand without forcing sealing material above the surface.)

5. Spread sand over hot material if needed

B. Fatigue or "alligator" cracks

1. Blow cracks

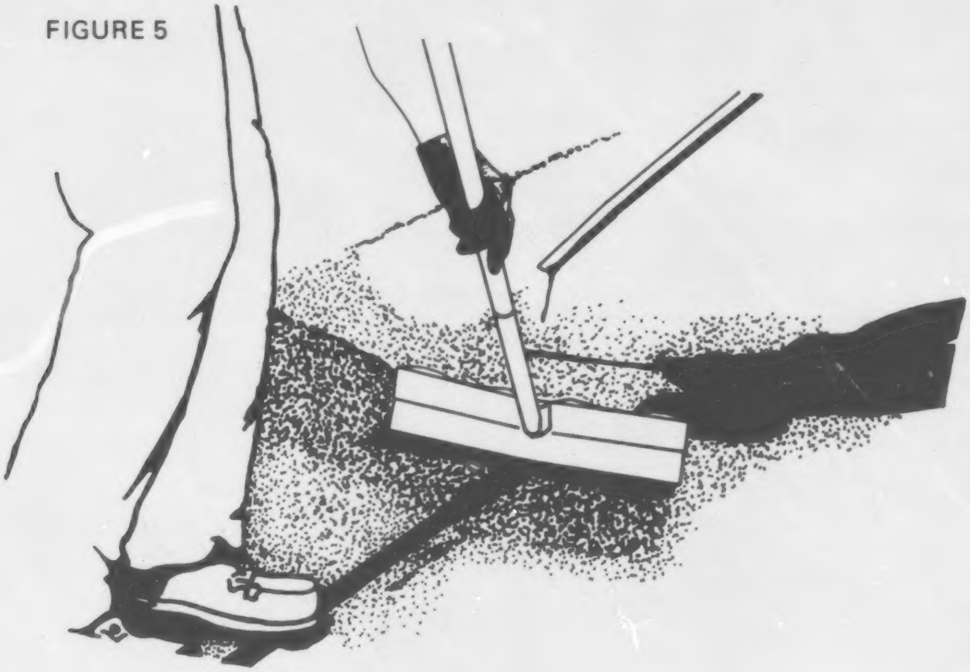
2. Sweep surface clean

INFORMATION SHEET

3. Apply sealing material over surface with a squeegee (Figure 5)

   EXAMPLE:

FIGURE 5

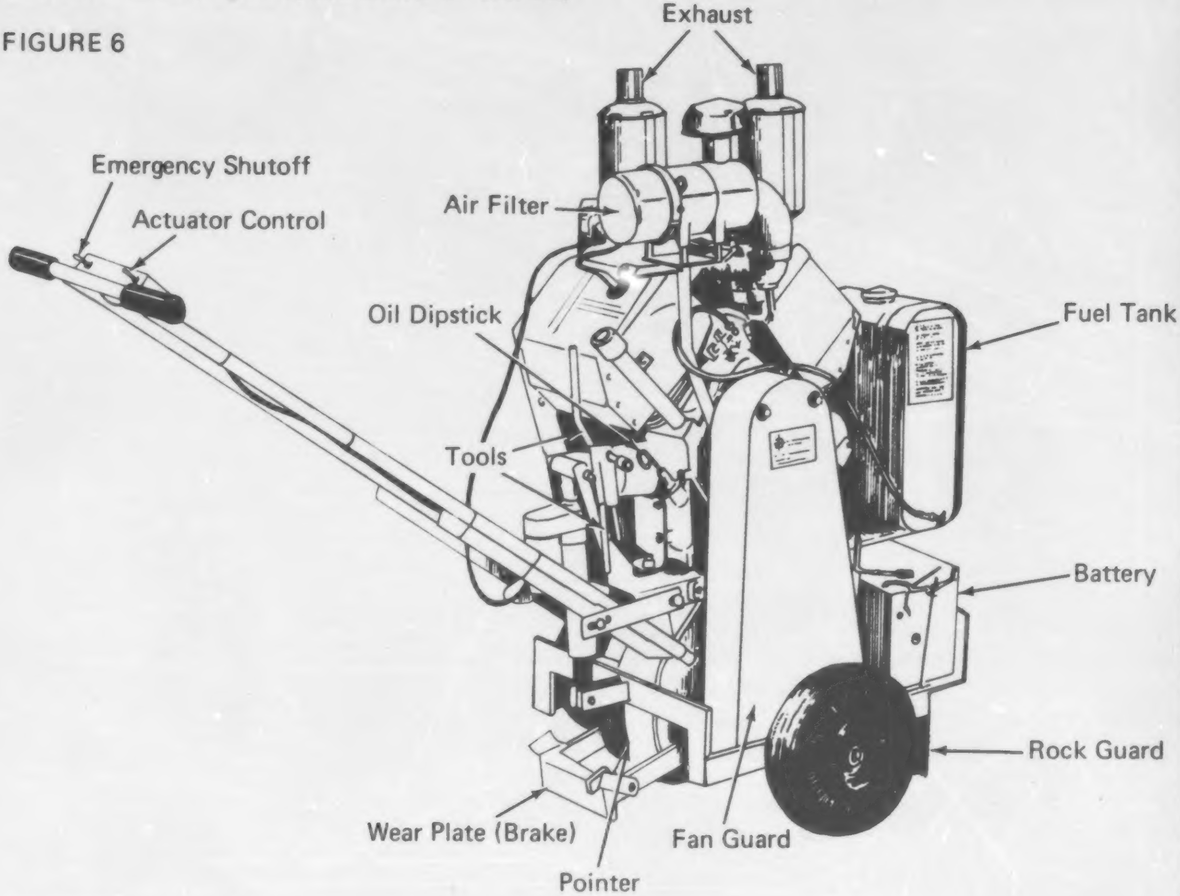


4. Apply covering material

   EXAMPLE: Sand, tar paper, screening, cinders

VI. Parts of a router (Figure 6; Job Sheets #1 and #2)

FIGURE 6


Exhaust
Emergency Shutoff
Actuator Control
Air Filter
Oil Dipstick
Fuel Tank
Tools
Battery
Rock Guard
Wear Plate (Brake)
Fan Guard
Pointer

Adapted with permission of Crafco, Inc.

INFORMATION SHEET

VII. Functions of controls on a typical router (Job Sheet #3)

(NOTE: Controls will vary with manufacturer and model.)

A. Emergency shutoff--Kills engine (See Figure 7)

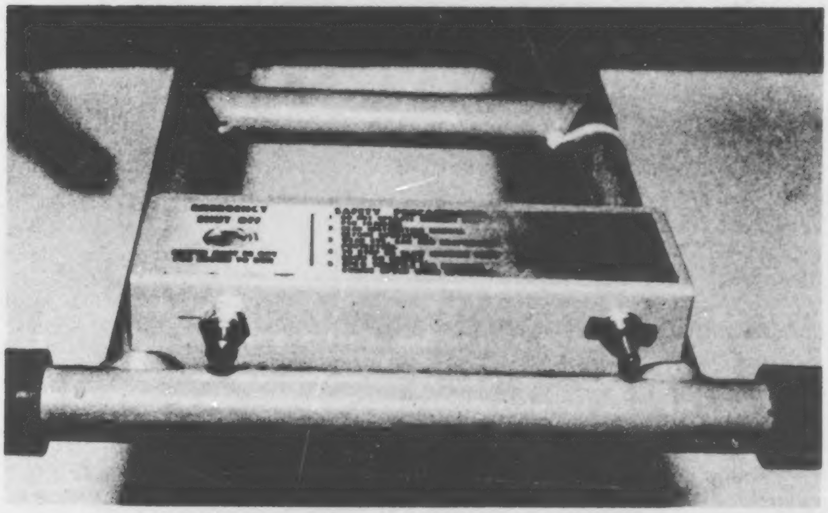
(NOTE: Operate with left thumb.)

B. Actuator,control--Moves cutters up and down (Figure 7)

(NOTE: Operate actuator control with right thumb.)

EXAMPLE:

FIGURE 7



Courtesy of Crafco, Inc.

C. Starter button--Cranks engine (See Figure 8)

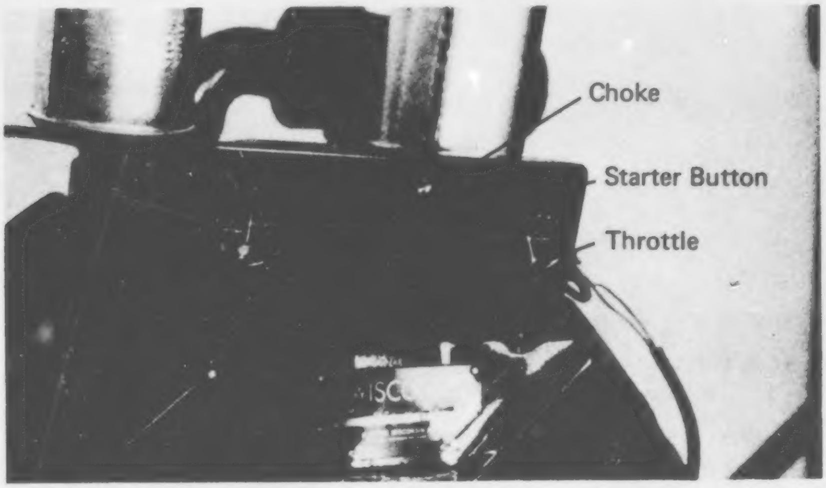
D. Choke --Regulates air/fuel ratio (See Figure 8)

INFORMATION SHEET

E. Throttle--Sets engine speed (Figure 8)

EXAMPLE:

FIGURE 8


Choke
Starter Button
Throttle

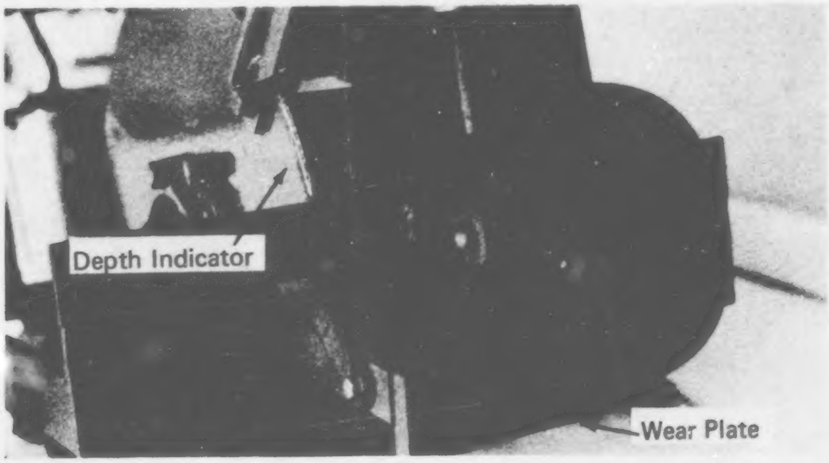
Courtesy of Crafco, Inc.

F. Depth indicator--Registers depth setting of cutters (See Figure 9)

G. Wear plate--Brakes router (Figure 9)

EXAMPLE:

FIGURE 9


Depth Indicator
Wear Plate

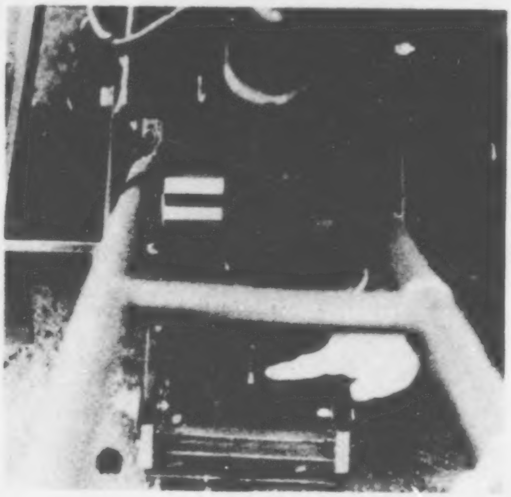
Courtesy of Crafco, Inc.

INFORMATION SHEET

H. Pointer--Cutting guide (Figure 10)

EXAMPLE:

FIGURE 10



Courtesy of Crafco, Inc.

VIII. Safety rules for router operation (Assignment Sheet #1)

A. Read operator's manual thoroughly: know your machine

B. Study departmental safety manual

C. Wear protective clothing

EXAMPLES: Hard hat
Visible vest
Safety goggles
Ear protection
Respirator, if surface is dry
Hard-toed shoes

D. Use traffic warning devices

E. Be sure all guards and shields are in place and in good condition

(NOTE: Router will throw rocks.)

INFORMATION SHEET

F. Work relaxed; don't fight the machine

(NOTE: Watch for fatigue and back strain. Take breaks as needed.)

G. Avoid back strain by using leverage when realigning for another approach

H. Plan work cycle so that you work away from traffic

IX. Rules for effective router operation (Job Sheets #1 and #4)

(NOTE: Some models cut toward the operator who walks backwards, guiding the machine. Other models cut away from the operator and must be guided while the operator walks forward. This second type of router is more difficult to control and requires greater care in operation.)

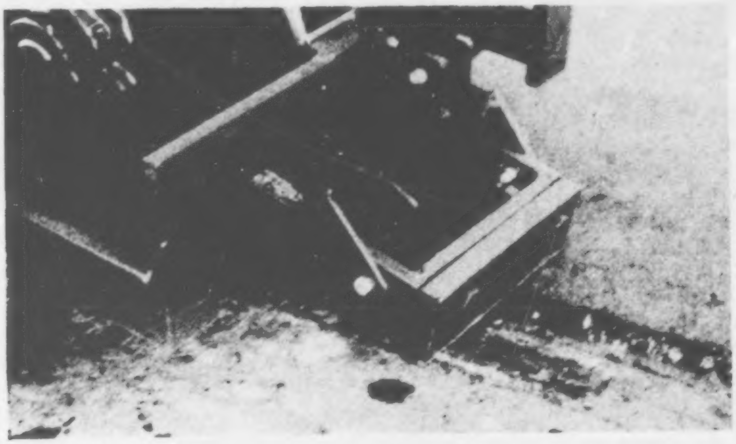
A. Perform all prestart inspection and maintenance procedures

B. Lower cutter head until cutters slightly touch road surface

C. On models that cut toward the operator, let wear plate drag on surface (Figure 11)

EXAMPLE:

FIGURE 11



Courtesy of Crafco, Inc.

D. Let machine propel itself; do not pull or push

(NOTE: Router will bounce or hammer against the surface if it is moved faster than it will cut.)

INFORMATION SHEET

E. Operate at full throttle

F. Use brake as required to keep machine under control

(NOTE: Tightly compacted surfaces will cause the machine to push toward or pull away from you.)

G. Operate uphill when working on grades

H. Replace cutters when they will no longer cut to desired depth

I. Rearrange or stagger cutters for wider cuts (Figure 12)

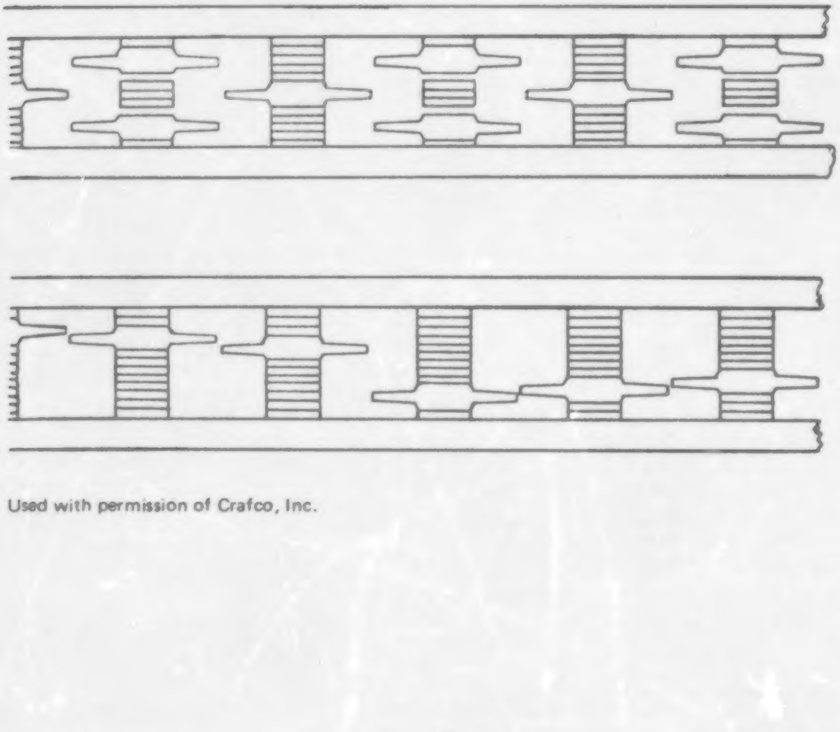
(NOTE: Place equal number of cutters and spacers on opposite pins to maintain balance.)

(CAUTION: Failure to balance cutters can result in permanent damage to machine and injury to operator.)

EXAMPLE:

FIGURE 12

Balanced Cutter Placement



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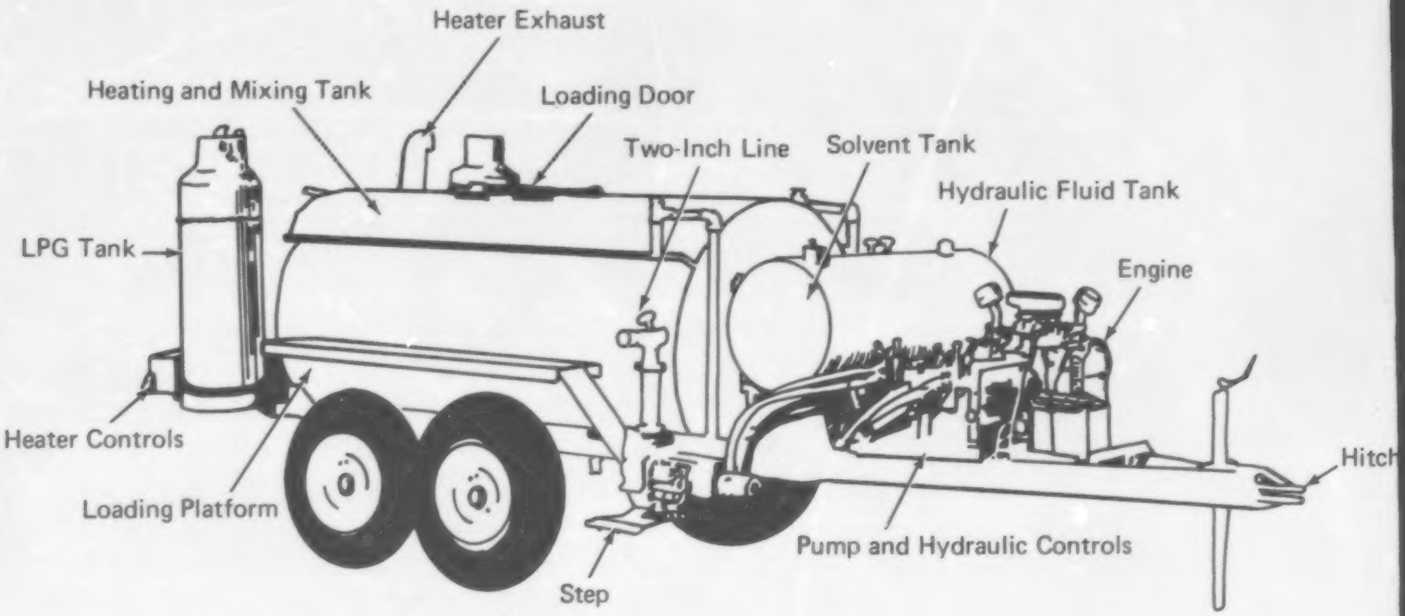
INFORMATION SHEET

X. Parts of a crack-sealing machine (Figure 13; Job Sheet #6)

(NOTE: Tank is divided into two sections, solvent tank and hydraulic fluid tank.)

FIGURE 13


Heater Exhaust
Heating and Mixing Tank
Loading Door
Two-Inch Line
Solvent Tank
Hydraulic Fluid Tank
LPG Tank
Engine
Heater Controls
Hitch
Loading Platform
Pump and Hydraulic Controls
Step

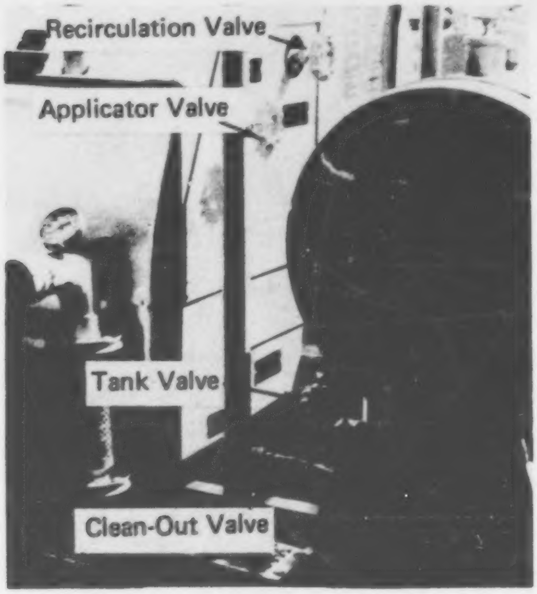
Adapted with permission of Crafco, Inc.

INFORMATION SHEET

XI. Controls and valves on a crack-sealing machine (Figures 14-18; Job Sheet #8)

A. Front of material tank

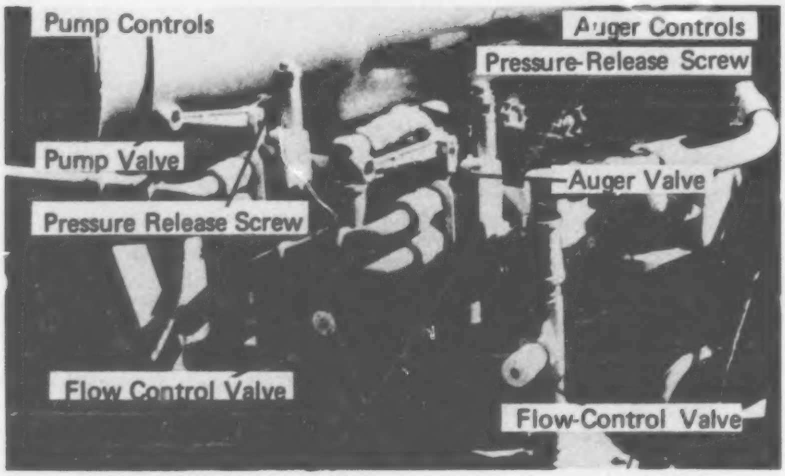
FIGURE 14


Recirculation Valve
Applicator Valve
Tank Valve
Clean-Out Valve

Courtesy of Crafco, Inc.

B. Hydraulic valves

FIGURE 15

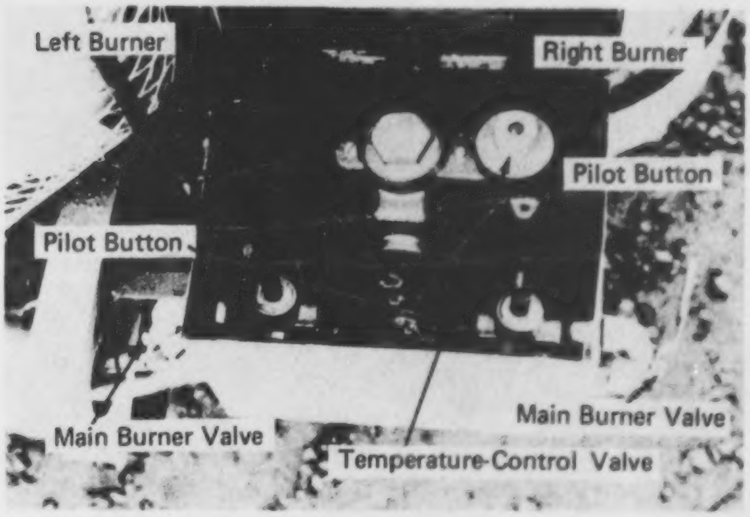

Pump Controls
Auger Controls
Pressure-Release Screw
Pump Valve
Auger Valve
Pressure Release Screw
Flow Control Valve
Flow-Control Valve

Courtesy of Crafco, Inc.

INFORMATION SHEET

C. Temperature-control housing

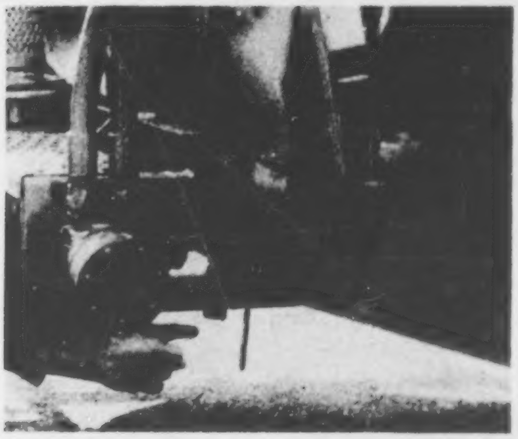
FIGURE 16


Left Burner
Right Burner
Pilot Button
Pilot Button
Main Burner Valve
Main Burner Valve
Temperature-Control Valve

Courtesy of Crafco, Inc.

D. Other controls

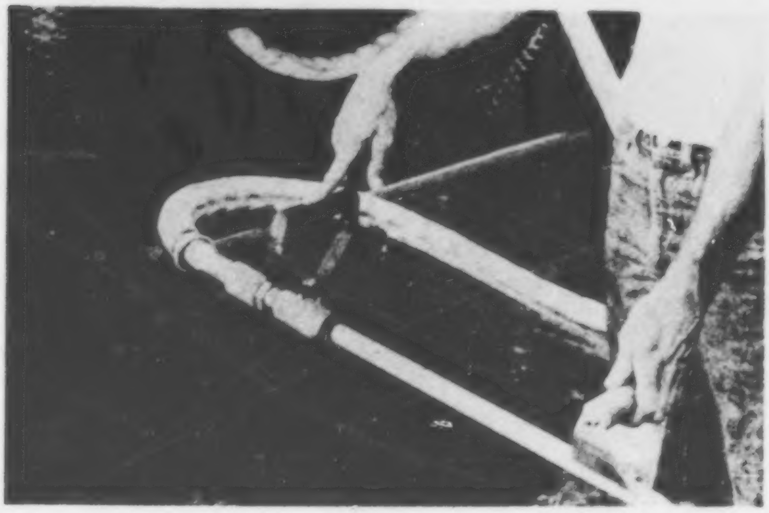
FIGURE 17 Drain Valve



Courtesy of Crafco, Inc.

INFORMATION SHEET

FIGURE 18 Hand-Applicator Control



Courtesy of Crafco, Inc.

XII. Functions of crack-sealing machine controls, valves, and gauges (Job Sheet #8)

A. Clean-out valve--Flushes system with solvent after use

(NOTE: Do not remove tank clean-out plug if material is in tank.)

B. Tank valve--Opens material tank to pump

C. Applicator valve--Controls flow of material to hand applicator

D. Recirculation valve--Controls flow of material returning to material tank

E. Drain valve--Used to drain solvent from lines after flushing system with solvent

F. Hand-applicator valve---Turns hand applicator on and off

G. Pump valve--Controls forward and reverse pump rotation

(NOTE: Place in DOWN position in forward rotation, in UP position for reverse rotation, in CENTER position for neutral.)

H. Auger valve--Controls forward and reverse auger rotation

(NOTE: Place in UP position for forward rotation, in DOWN position for reverse rotation, in CENTER position for neutral.)

INFORMATION SHEET

I. Flow-control valve for pump--Controls flow of hydraulic fluid to pump

(NOTE: The flow-control valves function as bypass valves. In the open position, they allow a small amount of fluid to pass to the pump or auger; in the closed position, they allow the bulk of hydraulic fluid to pass to them.)

J. Flow-control valve for auger--Controls flow of hydraulic fluid to auger

K. Temperature-control valve--Controls temperature of heat-transfer oil; located in temperature-control housing

L. Pressure regulator--Controls gas pressure to burners; located on propane tank

M. Pilot buttons--Allow flow of gas to pilot lights; located in temperature-control housing

N. Main burner valves--Control flow of gas from pressure tank to burners; located on either side of temperature-control housing

O. Pressure-release control screws--Used to adjust pressure at all pump speeds

(NOTE: The pressure is set at the factory but may need to be adjusted for operating conditions.)

P. Two-inch line--Used for loading machine with liquid material

Q. Temperature gauges--Register temperature of material

EXAMPLES: Sealant-material gauges--One located atop material tank, one on 2-inch line; register temperature of material flowing through line

Heat-transfer oil gauge--Located on the right-hand side next to propane tank; measures temperature of oil

XIII. Safety rules for operating crack-sealing machine (Assignment Sheet #1)

(NOTE: Think ahead! Don't learn safety the hard way.)

A. Read operator's manual thoroughly: know your machine

B. Study departmental safety manual

C. Wear protective clothing

EXAMPLES:
Hard hat
Visible vest
Safety goggles
Insulated gloves
Respirator if needed

(NOTE: Fumes can cause nausea and vomiting.)

INFORMATION SHEET

D. Use traffic control devices

E. Carry fire extinguisher

(NOTE: Place extinguisher a short distance from heating unit.)

F. Carry first-aid kit with burn-treatment supplies

G. Use caution when adding solid material to liquid material

(NOTE: Turn off auger. Lower block carefully; do not splash hot liquid on yourself or others.)

H. Avoid contact with material

(CAUTION: Material is hot!)

I. Do not touch any part of heating unit with bare hands

(CAUTION: Equipment is hot!)

J. Make sure all couplings and connections are secure

K. Keep hose from kinking

(CAUTION: If hose is kinked, flow is blocked. Hose will jump when full pressure is restored, causing loss of control and possible severe burns.)

L. Keep water out of heating unit

(CAUTION: Water will displace either heat-transfer oil or sealant. This can be hazardous when unit reaches operating temperature.)

M. Clean unit thoroughly before changing types of material

(CAUTION: Do not mix emulsions and asphalt cutback material. Emulsions will boil and foam at usable temperatures for cutback material. Serious burns can result.)

N. Keep machine clean

XIV. Rules for effective crack-sealing machine operation (Job Sheets #5, #7, #8, and #9)

A. Heating unit

1. Perform all prestart inspection and maintenance procedures

2. Preheat tank

3. Feed solid material at intervals that will allow auger to rotate continuously

(NOTE: Too much solid material at any one time will stop the auger and slow the melting process.)

4. Heat material to temperature specified by manufacturer

INFORMATION SHEET

5. Maintain pump pressure recommended by manufacturer
6. Maintain material level above auger

   (NOTE: To reduce splashing, keep material level as full as possible.)

7. Clean machine thoroughly after each use

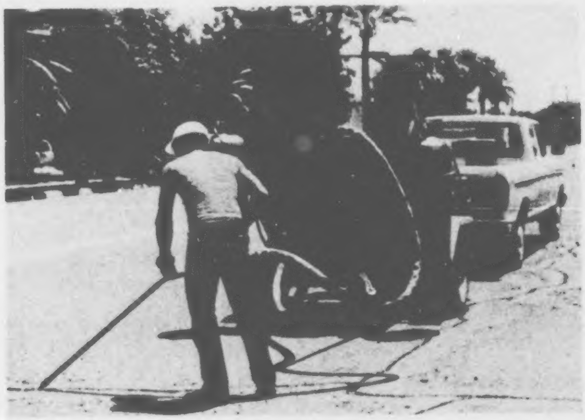
   (NOTE: If machine is to be used again the next day, material can be left in the tank but must be kept at a usable temperature. Once material is cold, heating to proper temperature is difficult. Machine is equipped with 110-volt heating unit. Be sure to remove cord before operating.)

B. Hose and applicator

1. Heat hose and nozzle in heating chamber before operation begins
2. Be sure connections are tight
3. Use correct-sized and shaped nozzle for the job
4. Maintain firm grip and hold steady
5. Hold nozzle at an angle (Figure 19)

   (NOTE: Nozzle will jerk if spray is directed straight down.)

FIGURE 19



Courtesy of Crafco, Inc.

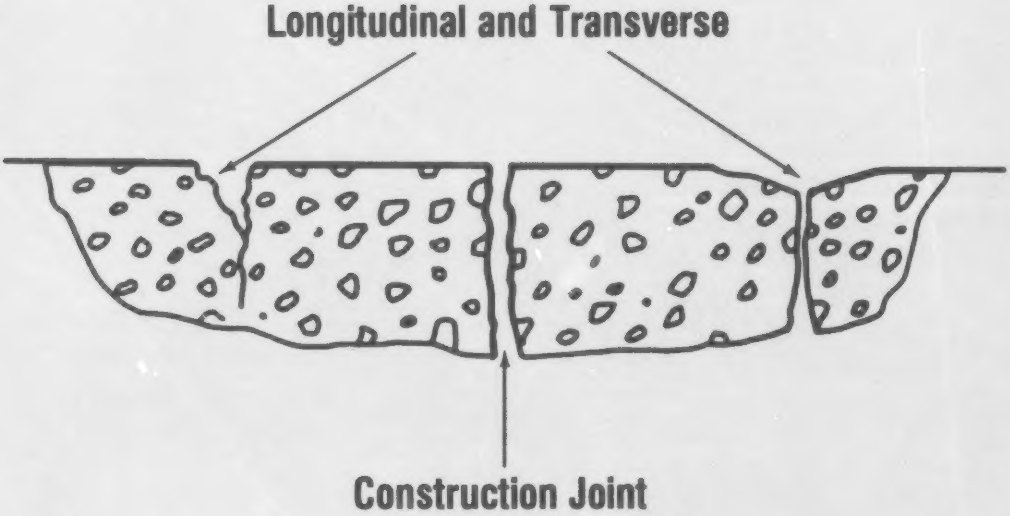
INFORMATION SHEET

6. Start at far end of crack
7. Walk backwards, holding applicator in front of you (See Figure 19.)
8. Place nozzle in tank opening when not in use

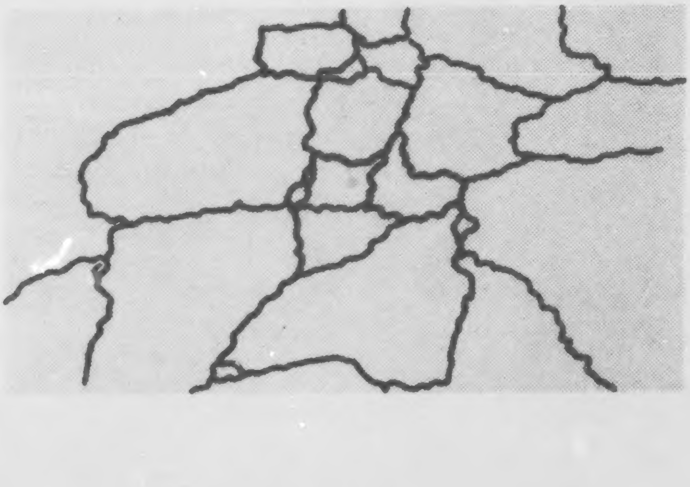
   (NOTE: Open applicator valve to keep hose warm and flow unobstructed. If hose plugs, it will have to be immersed in the material tank and then cleaned. This is a very messy job. Keep hose warm.)

9. Clean thoroughly after each use

Types of Cracks

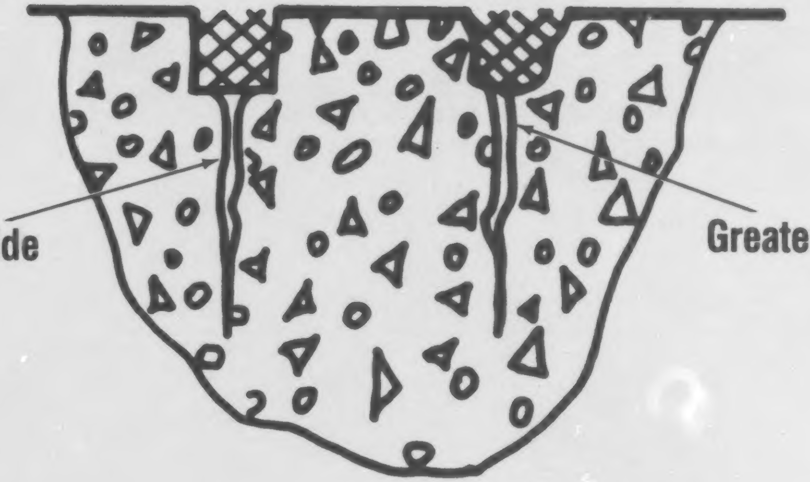

Longitudinal and Transverse
Construction Joint

Fatigue or ''Alligator''



Asphalt Repairs

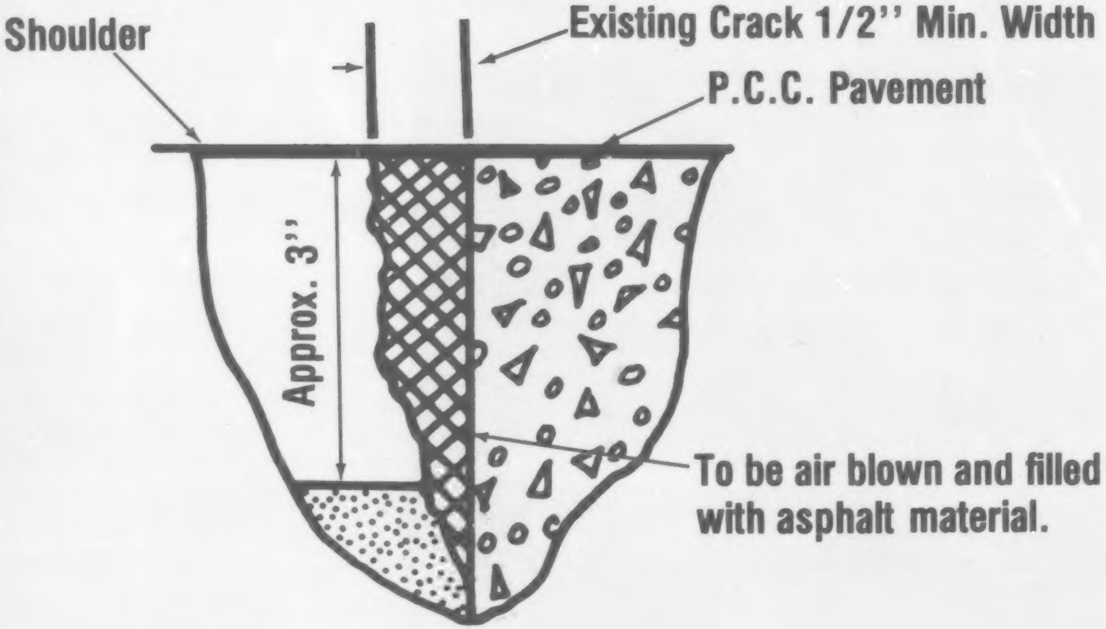
Rout 1/2 '' Wide x 3/4'' to 1'' Deep. Fill with Sealant.


Less than 3/8'' Wide
Greater than 3/8'' Wide

TM #2

DOT II - 911

Concrete Repairs
Joints 1/2'' to 2'' Wide


Shoulder
Existing Crack 1/2'' Min. Width
P.C.C. Pavement
Approx. 3''
To be air blown and filled with asphalt material.

CRACK-SEALING EQUIPMENT
UNIT XVII

ASSIGNMENT SHEET #1--DISCUSS SAFETY EQUIPMENT

NAME ________________________ SCORE ____________

Use all safety equipment and protective clothing to keep yourself and others free of injury. The best protection is a "safety-conscious" attitude.

Write a brief statement telling why each of the following is needed.

A. Hard-toed shoes for routing--________________________

____

B. Visible vest for routing and crack sealing--________________

____

C. Ear protection for routing--________________________

____

D. Respirator for routing --________________________

____

E. Respirator for sealing cracks--________________________

____

F. Safety goggles for routing--________________________

____

G. Safety goggles for crack sealing--____________________

____

H. Insulated gloves for crack sealing--____________________

____

I. Guards and shields on router--________________________

____

J. Fire extinguisher--________________________

____

K. First-aid kit--________________________

____

CRACK-SEALING EQUIPMENT
UNIT XVII

ANSWERS TO ASSIGNMENT SHEET

(NOTE: Answers will vary and should be evaluated to the instructor's satisfaction.)

A. To protect feet from rocks and from accidents with the cutters

B. So operator can be seen by drivers

C. To protect hearing and prevent deafness

D. To prevent breathing dust when routing dry surfaces

E. To prevent breathing fumes and atomized oil

F. To protect eyes from cement, asphalt, and dust particles

G. To protect eyes from fumes and oil

H. To protect hands from burns

I. To protect operator and other workers from thrown rocks and material

J. To put out fires

K. To treat burns and other injuries

CRACK-SEALING EQUIPMENT
UNIT XVII

JOB SHEET #1--PERFORM PRESTART INSPECTION AND MAINTENANCE PROCEDURES ON ROUTER

I. Equipment and materials

- A. Router
- B. Operator's manual
- C. Engine oil
- D. Fuel
- E. Lubricants
- F. Grease gun
- G. Rags
- H. Water or air supply

II. Procedure

(NOTE: Deficiencies should be corrected immediately or reported to the proper authority. Do not operate defective equipment.)

- A. Make a walk-around visual inspection for broken, worn, or missing parts and leaks
- B. Check engine oil levels; add or change engine oil if necessary
- C. Check fuel level; fill tank if needed
- D. Check battery connections for tightness and corrosion
- E. Check battery electrolyte level; add water if needed
- F. Check air cleaner; remove and clean filter if necessary

  (NOTE: Do not pound or tap dust from filter. Clean with air or water.)
- G. Check tires
- H. Clean all grease fittings and lubricate according to manufacturer's specifications
- I. Check drive belts for tightness
- J. Check electrical wire connections and insulation
- K. Check gauges
- L. Check levers and controls for proper functioning

JOB SHEET #1

M. Check shields and guards

N. Check cutters for wear; replace if necessary

O. Check cutters for balanced placement; adjust if necessary

P. Check bolts; tighten if necessary

CRACK-SEALING EQUIPMENT
UNIT XVII

JOB SHEET #2--SERVICE A ROUTER

I. Equipment and materials

- A. Router
- B. Operator's manual
- C. Tool kit
- D. Air supply
- E. Grease gun
- F. Lubricants
- G. Cleaning solvents
- H. Rags
- I. Water
- J. Engine oil
- K. Fuel

II. Procedure

(NOTE: Follow departmental preventative maintenance program when servicing equipment. Refer to operator's manual for lubrication chart and for servicing specific components and attachments.)

A. Visually inspect for broken, worn, or missing parts; look for leaks

(NOTE: Major repairs and replacements should be reported to the proper authority and completed by a trained mechanic.)

B. Check engine oil level, filter, lines, and hoses; add or change engine oil if needed

(NOTE: Be sure unit is level.)

C. Clean air filter; replace if necessary

D. Check fuel level and fuel filters; fill fuel tank if necessary

E. Check battery electrolyte level, battery cables, and connectors; add water if needed

(CAUTION: Keep sparks and fire away from battery.)

F. Check exhaust system for loose connections and holes

JOB SHEET #2

G. Check all bolts; tighten if necessary

H. Check drive belts for tension and wear; adjust or replace if necessary

(CAUTION: Do not overtighten V-belts.)

I. Clean and lubricate all grease fittings according to operator's manual

J. Check condition of tires

K. Check tire pressure; inflate to recommended pressure

L. Check all guards and shields; repair if needed

M. Check cutters for wear; replace if necessary

N. Check cutter alignment; adjust if necessary

O. Clean cooling fins on engine

CRACK-SEALING EQUIPMENT
UNIT XVII

JOB SHEET #3--START, WARM UP, OPERATE, AND SHUT DOWN A ROUTER

I. Equipment and materials

  A. Router

  B. Operator's manual

II. Procedure

  A. Read operator's manual thoroughly

  B. Raise cutter mechanism if not already raised

  C. Pull choke out

  D. Open throttle half way

  (CAUTION: Locate emergency stop switch or button before operating.)

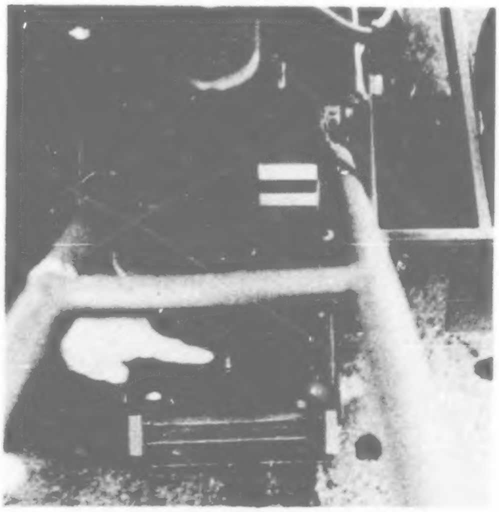
  E. Engage starter

  F. Push choke in after engine starts

  G. Open throttle

  H. Position machine over joint and line up pointer with joint (Figure 20)

FIGURE 20



Courtesy of Crafco, Inc.

JOB SHEET #3

I. Lower cutter mechanism until cutters slightly touch road surface

J. Practice until you feel you have control of router

K. Stop router

L. Raise cutter mechanism

M. Turn off engine

CRACK-SEALING EQUIPMENT
UNIT XVII

JOB SHEET #4--ROUT AND BLOW CRACKS

I. Equipment and materials

- A. Routing machine
- B. Operator's manual
- C. Air compressor with high-pressure air hose and nozzle
- D. Transport vehicle
- E. Tool kit
- F. Recommended safety equipment
    1. Hard hat
    2. Hard-toed shoes
    3. Goggles
    4. Respirator
    5. Close-fitting clothing
    6. Visible vest
- G. Traffic control devices

II. Procedure

- A. Perform all prestart inspection and maintenance procedures
- B. Read operator's manual thoroughly
- C. Stagger cutters on drum to desired routing width
- D. Transport routing machine and compressor to job site
- E. Place traffic control devices
- F. Position routing machine at starting point, with routing tool directly over crack
- G. Check all safety devices; make sure guards and shields are in place and in good condition
- H. Start router
- I. Lower routing head gradually until cutters rout to desired depth

JOB SHEET #4

J. Guide routing tool along crack

(NOTE: Do not push or force the router.)

K. Stop router at end of section or crack

L. Raise cutter mechanism

M. Move to next crack and repeat steps H through L

(NOTE: Check cutters for wear every 250 to 300 feet of routing. Replace cutters as needed.)

N. Move router off roadway

O. Shut down router

P. Start air compressor

Q. Connect air hose to compressor

R. Connect blower nozzle to hose

S. Check all connections and couplings to be sure that they are secure

T. Pick up blow pipe

(NOTE: Hold at handhold with one hand, and operate the control valve with the other hand.)

U. Open control valve and blow all dust, cuttings, and debris out of cracks, grooves, and off the road surface

(NOTE: Stand on one side of the roadway or pavement and blow debris to the opposite side. Blow material out of the crack, then across the pavement.)

V. Continue until job is completed

W. Shut down the compressor

X. Make a final walk-around inspection of all equipment; make a list of loose, broken, missing, or worn parts, and give it to the proper person

CRACK-SEALING EQUIPMENT
UNIT XVII

JOB SHEET #5--PERFORM PRESTART INSPECTION AND MAINTENANCE PROCEDURES ON CRACK-SEALING MACHINE

I. Equipment and materials

A. Crack-sealing machine

B. Operator's manual(s) for crack-sealing machine and engine

C. Engine oil

D. Engine coolant

E. Hydraulic fluid

F. Fuel

G. Lubricants

H. Grease gun

I. Rags

II. Procedure

(NOTE: Deficiencies should be corrected immediately or reported to the proper authority. Do not operate defective equipment.)

A. Make a walk-around visual inspection for leaks and broken, worn, or missing parts

B. Check engine oil level; add or change engine oil if needed

C. Check engine coolant level; add coolant if needed

D. Check hydraulic reservoir level; add fluid if necessary

(NOTE: Fluid should be three to five inches from top of tank.)

E. Check fuel level; fill tank if necessary

F. Check battery connections for tightness and corrosion

G. Check battery electrolyte level; add water if needed

H. Check air cleaner; remove and clean filter if necessary

I. Check tires

J. Clean all grease fittings and lubricate according to operator's manual

K. Check hydraulic system for leaking lines and connections, bent or kinked lines, and lines rubbing against other parts

JOB SHEET #5

L. Check drive belts for tightness

M. Check electrical wire connections and insulation

N. Check gauges

O. Check levers and controls for proper functioning

P. Check lights

Q. Check safety devices

R. Check hitch

S. Check hose and nozzle

T. Check pump for proper operation; adjust as needed

U. Check all couplings and connections; tighten if necessary

V. Fill propane storage tanks

W. Check heat-transfer oil levels; add oil if needed

(NOTE: Be sure unit is level.)

(CAUTION: Do not overfill.)

X. Check solvent supply; add solvent if needed

(CAUTION: Solvent must be compatible with sealant material.)

Y. Clean engine cooling fins

CRACK-SEALING EQUIPMENT
UNIT XVII

JOB SHEET #6--SERVICE A CRACK-SEALING MACHINE

I. Equipment and materials

A. Crack-sealing machine

B. Operator's manual

C. Tool kit

D. Air supply

E. Grease gun

F. Lubricants

G. Cleaning solvents

H. Rags

I. Water

J. Engine coolant

K. Engine oil

L. Hydraulic fluid

M. Solvent

N. Tire pressure gauge

O. Fuel

II. Procedure

(NOTE: Follow departmental preventive maintenance program when servicing equipment. Refer to operator's manual for lubrication chart and servicing for specific components and attachments.)

A. Visually inspect for leaks and broken, worn, or missing parts

(NOTE: Major repairs and replacements should be reported to the proper authority and completed by a trained mechanic.)

B. Check engine oil level, filter, lines, and hoses; add or change engine oil if needed

C. Check engine coolant level, radiator cap, hose, and radiator if applicable; add coolant if needed

(CAUTION: Do not remove radiator cap unless engine is cool; then, open cap slowly to release pressure.)

JOB SHEET #6

D. Clean air filter; replace if necessary

E. Check fuel level, fuel filters, and sediment bowl (where applicable); fill fuel tank if necessary

F. Check battery electrolyte level, battery cables, and connectors; add water if needed

(CAUTION: Keep sparks and fire away from battery.)

G. Check exhaust system for loose connections and holes

H. Check hydraulic fluid level, filters, hose, lines, and fittings; look for leaks; add fluid if needed

I. Check solvent level; add solvent if needed

J. Clean cooling fins on engine

K. Check drive belts for tension and wear; adjust or replace if necessary

L. Check wiring, insulation, and connections

M. Clean and lubricate all grease fittings according to operator's manual

N. Check condition of tires

O. Check tire pressure; inflate to recommended pressure if necessary

P. Check all safety devices; repair if necessary

Q. Check major components and/or accessories

R. Check calibration on temperature-control valve

(NOTE: See operator's manual for procedure.)

CRACK-SEALING EQUIPMENT
UNIT XVII

JOB SHEET #7–LIGHT BURNERS

I. Equipment and materials

   A. Crack-sealing machine

   B. Operator's manual

   C. Sufficient propane in tanks to operate burners

   D. Matches

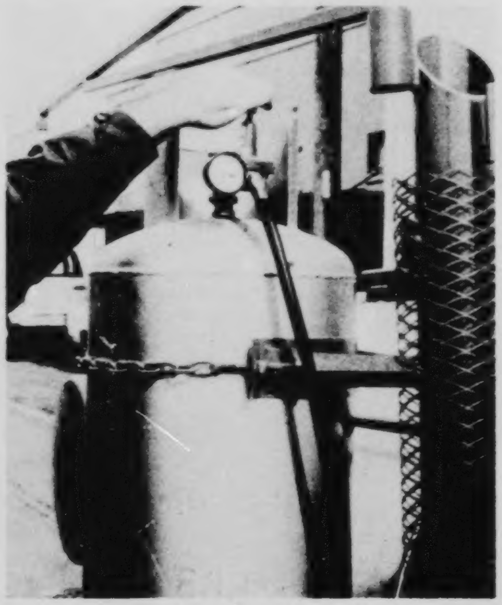
   E. Long-handled torch

II. Procedure

   A. Read operator's manual thoroughly

   B. Open LPG tank valves *slowly* (Figure 21)

FIGURE 21



Courtesy of Crafco, Inc.

   C. Set pressure regulators according to manufacturer's recommendations

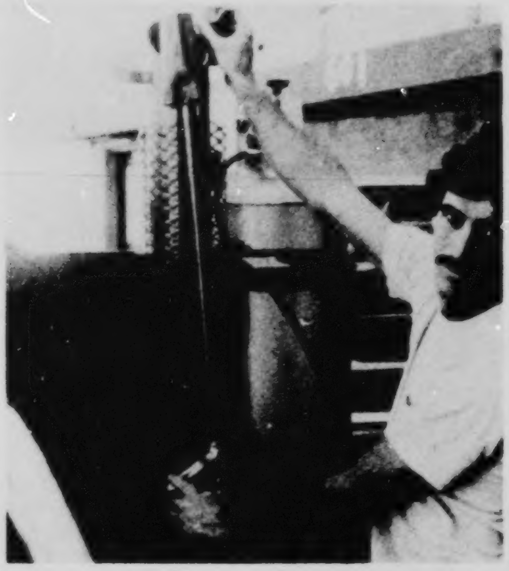
   D. Hang torch on hook

JOB SHEET #7

E. Hold match at top of torch and open valve on handle (Figure 22)

(NOTE: Regulate flame by adjusting valve.)

FIGURE 22

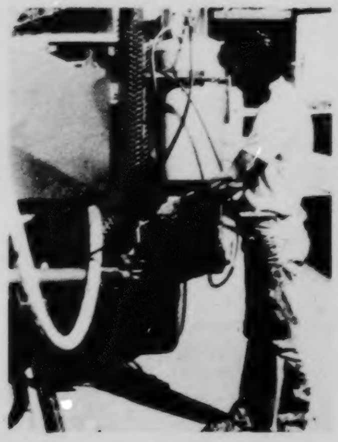


Courtesy of Crafco, Inc.

F. Hold right-hand pilot button down

G. Light right-hand burner with torch while holding button down (Figure 23)

FIGURE 23



Courtesy of Crafco, Inc.

JOB SHEET #7

H. Hold pilot button down for thirty seconds, until pilot burns steadily

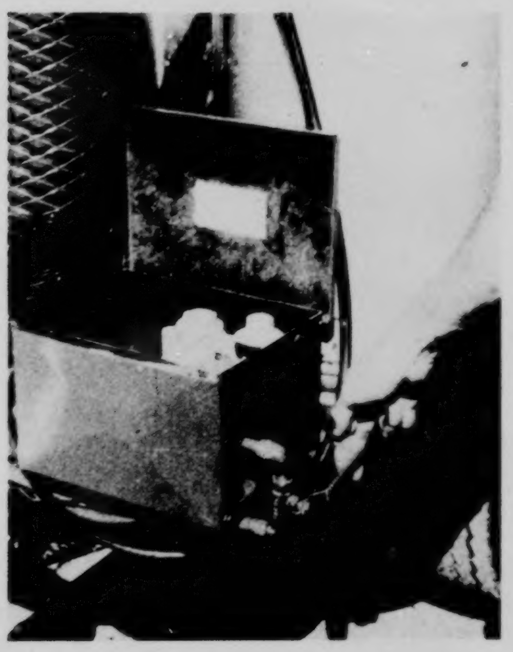
(NOTE: Pilot must heat thermocouple before burner will ignite.)

I. Repeat steps F-H on left-hand pilot button and burner

J. Shut off valve on torch

K. Open main burner valves located on sides of heating element box (Figure 24)

FIGURE 24



Courtesy of Crafco, Inc.

L. Set temperature control to desired temperature

(CAUTION: Do not exceed 500°F.)

CRACK-SEALING EQUIPMENT
UNIT XVII

JOB SHEET #8--START, WARM UP, AND OPERATE CRACK-SEALING MACHINE

I. Equipment and materials

   A. Crack-sealing machine

   B. Operator's manual

   C. Asphalt material

   D. Matches

   E. Recommended safety equipment

      1. Hard hat

      2. Visible vest

      3. Respirator

      4. Goggles

      5. Insulated gloves

      6. Fire extinguisher

      7. First-aid kit

II. Procedure

   A. Read operator's manual thoroughly

   B. Make sure all valves are in correct position for starting machine

      1. Clean-out valve--Closed

      2. Tank valve--Closed

      3. Applicator valve--Closed

      4. Recirculation valve--Closed

      5. Drain valve--Closed

      6. Hand-applicator valve--Closed

      7. Hydraulic control valves--Off

JOB SHEET #8

8. Flow-control valve for auger--Open

   (NOTE: The flow-control button is below the hydraulic lever. Open to reduce pressure and eliminate stress on hoses and seals. Close gradually as sealant heats and liquefies.)

C. Light burners

D. Put two blocks of sealant material into material tank

E. Allow material to reach liquid state

F. Move ignition switch to ON

G. Pull out choke

   (NOTE: Leave choke approximately three-quarters closed, and gradually open it as engine warms up.)

H. Push starter button, or turn key to start engine

I. Start agitation by moving auger control lever *up* to forward rotation position

   (NOTE: If auger jams, reverse direction of rotation by moving lever down; then return to up position.)

J. Add sealant as blocks liquefy; allow one to melt before adding another

   (NOTE: Keep sealant level above auger; keep tank as full as possible. Turn auger off while adding material.)

   (CAUTION: Do not let hot oil splash on you or other workers.)

K. Open recirculation valve to allow sealant to recirculate

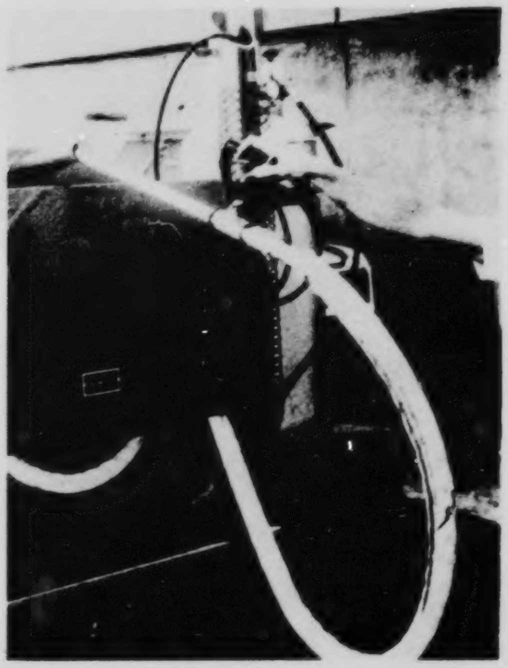
L. Continue to agitate and recirculate material until it reaches application temperature

M. Engage pump for forward rotation by moving pump lever to *down* position when material reaches application temperature

JOB SHEET #8

N. Remove hose from heating chamber; place hand applicator in tank opening with valve in ON position (Figure 25)

FIGURE 25



Courtesy of Crafco, Inc.

O. Open applicator valve on tank

P. Adjust recirculation valve for desired flow through applicator

(CAUTION: Do not close recirculating valve completely during operation; pressure will build up and lines may explode.)

Q. Turn hand-applicator valve to OFF and remove applicator from tank

R. Position yourself at crack to be sealed and turn hand-applicator valve to ON

S. Hold hose at an angle

(NOTE: Keep hose from kinking and keep it away from your body. Maintain a firm grip and hold steady.)

T. Start at far end of crack and walk backward, sealing in front of you

U. Seal cracks

(NOTE: Follow manufacturer's recommendations.)

JOB SHEET #8

V. Turn off hand-applicator valve when entire length of crack has been sealed

(NOTE: For low-volume work, place hose in tank. Do not let hose cool; replace in tank often.)

W. Move to next crack

(CAUTION: Place applicator in tank opening with valve open when not in use. This keeps the hose warm and the flow unobstructed. Do not allow material to solidify in hose or nozzle.)

X. Repeat procedure until job is completed

Y. Proceed to Job Sheet #9 to perform shutdown and cleaning procedures

CRACK-SEALING EQUIPMENT
UNIT XVII

JOB SHEET #9--SHUT DOWN AND CLEAN CRACK-SEALING MACHINE

I. Equipment and materials

- A. Crack-sealing machine
- B. Operator's manual
- C. Solvent

II. Procedure

- A. Turn off hand-applicator valve
- B. Close main burner valves
- C. Place applicator in tank opening with applicator valve open
- D. Reverse material pump for approximately one minute
- E. Close recirculation valve completely
- F. Stop material pump
- G. Close tank valve
- H. Remove applicator from tank, leaving valve open

JOB SHEET #9

I. Open clean-out valve (Figure 26)

(NOTE: Clean-out valve allows solvent to run through system.)

(CAUTION: Do not allow solvent to enter material tank.)

FIGURE 26

Courtesy of Crafco, Inc.

J. Engage pump for forward rotation by moving lever down

K. Pump solvent through system until it flows freely through hand applicator

L. Close clean-out valve

M. Disengage pump by moving lever to middle position

N. Open drain valve

O. Reverse pump rotation until all fluid is emptied from lines

P. Stop pump

Q. Close drain valve

R. Shut down engine

S. Close propane tank valves

JOB SHEET #9

T. Release pressure from hose

U. Close hand-applicator valve

V. Disconnect hose

(NOTE: If hose is plugged, immerse in material tank. When material is liquefied, empty hose and clean thoroughly.)

W. Coil hose, and store properly in heating chamber

(NOTE: If storing unit overnight, plug in heating element to 110-volt supply line. Be sure to disconnect before using machine.)

CRACK-SEALING EQUIPMENT
UNIT XVII

TEST

NAME ______________________________ SCORE ______________

1. Match terms associated with crack-sealing equipment to their correct definitions. Write the correct numbers in the blanks.

______a. To remove dirt and dust with forced air

______b. Material that dissolves other materials

______c. Asphalt material mixed with light volatile oil; applied at high temperatures

______d. Self-contained unit with heater, agitator, material tank, pump, applicator, and cleaning system; used to fill cracks and joints in asphalt and concrete surfaces

______e. Break in the general continuity of pavement

______f. Machine used to widen cracks

______g. Asphalt material suspended in water; applied at normal temperatures

______h. Break that runs across width of roadway

______i. Paving mixture usually composed of portland cement, aggregate, and water

______j. Asphalt material applied to cracks and joints to protect against wear and weather and to provide a continuous smooth surface

______k. Paving mixture composed of crushed rock or other aggregate cemented with asphalt material

______l. Break that runs along length of roadway

______m. Space between two sections of pavement

1. Joint
2. Asphalt cutback
3. Crack-sealing machine
4. Sealant
5. Solvent
6. Router
7. Longitudinal crack
8. Blow
9. Asphalt emulsion
10. Transverse crack
11. PCC (portland cement concrete) pavement
12. Asphalt pavement
13. Crack

2. Select from the following list uses of crack-sealing equipment in highway maintenance. Write an "X" in the blank before each correct answer.

______a. Sealing asphalt cracks

______b. Sealing bridge expansion joints

______c. Sealing asphalt joints

______d. Sealing concrete cracks

TEST

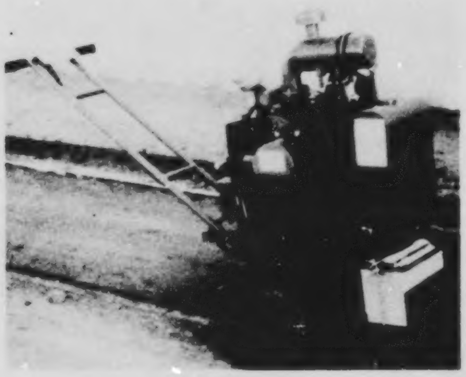
______e. Sealing cracks in equipment

______f. Sealing joints between concrete road and asphalt shoulders

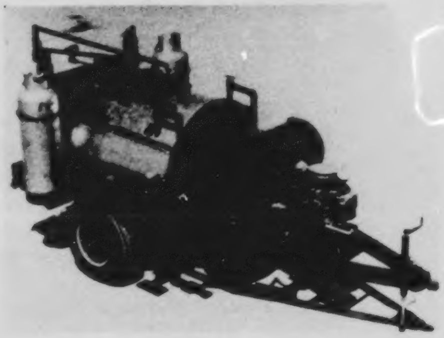
______g. Sealing concrete joints

______h. Sealing fatigue cracks in concrete

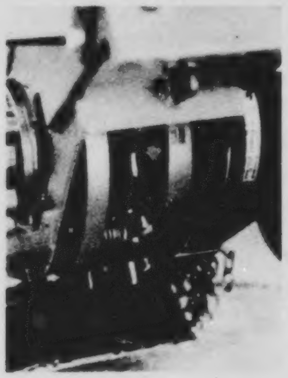
3. Label crack-sealing equipment. Write the correct names in the blanks.



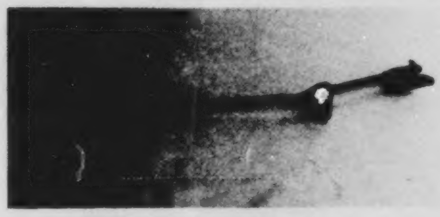
a. ______________________________



b. ______________________________



c. ______________________________



d. ______________________________

TEST

4. Match types of cracks to their correct descriptions. Write the correct numbers in the blanks. Answers may be used more than once.

_____a. Have essentially parallel sides and usually extend to the subgrade; widths vary from 1/4" to 2"

_____b. Spread over the surface in shallow, interconnected patterns; widths vary from hairline to 1/4" (asphalt only)

_____c. Wedge-shaped at top and closed at bottom; widths vary from hairline to 1"

_____d. Depressed at surface on each side; widths vary from 1/2" to 2" (asphalt only)

1. Construction joints
2. Fatigue or "alligator"
3. Longitudinal and transverse

5. Arrange in order steps in a crack-sealing operation. Write a "1" in the blank before the first step, a "2" before the second step, and so on.

a. Longitudinal and transverse cracks and construction joints

_____1) Heat asphalt-sealing material

_____2) Blow cracks with portable blower or air compressor

_____3) Rout any cracks less than 3/8" to 1/2" wide and 3/4" to 1" deep

_____4) Seal cracks from bottom to top

_____5) Spread sand over hot material if needed

b. Fatigue or "alligator" cracks

_____1) Apply sealing material over surface with a squeegee

_____2) Sweep surface clean

_____3) Apply covering material

_____4) Blow cracks

TEST

6. Identify parts of a router. Write the correct numbers in the blanks.

_____a. Air filter

_____b. Battery

_____c. Rock guard

_____d. Wear plate (brake)

_____e. Fan guard

_____f. Oil dipstick

_____g. Emergency shutoff

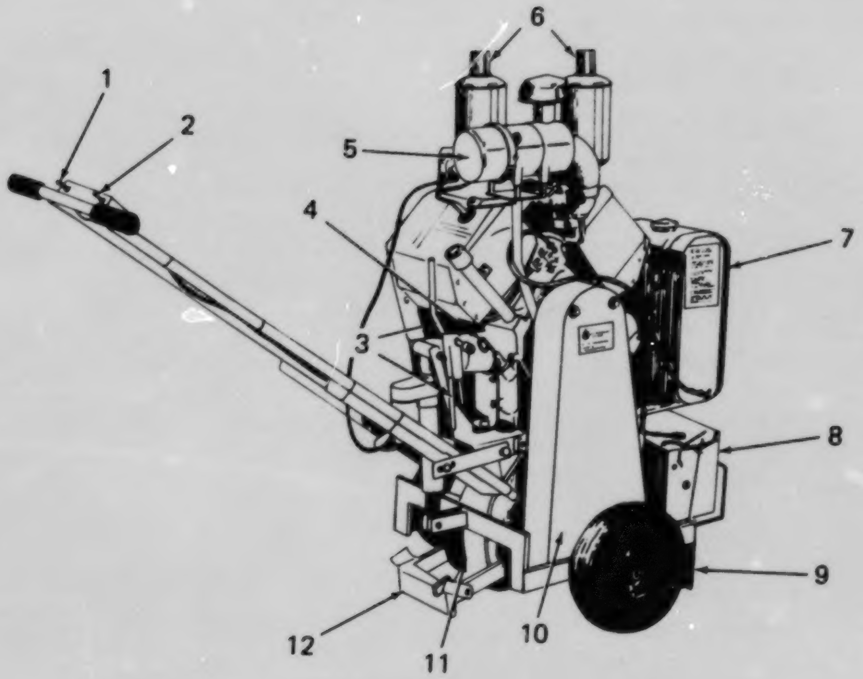
_____h. Pointer

_____i. Fuel tank

_____j. Tools

_____k. Actuator control

_____l. Exhaust



TEST

7. Match controls on a typical router to their correct functions. Write the correct numbers in the blanks.

_____a. Cutting guide
_____b. Regulates air/fuel ratio
_____c. Kills engine
_____d. Brakes router
_____e. Registers depth setting of cutters
_____f. Cranks engine
_____g. Moves cutters up and down
_____h. Sets engine speed

1. Choke
2. Throttle
3. Wear plate
4. Starter button
5. Depth indicator
6. Actuator control
7. Pointer
8. Emergency shutoff

8. State five safety rules for router operation.

a. ______________________________
b. ______________________________
c. ______________________________
d. ______________________________
e. ______________________________

9. State six rules for effective router operation.

a. ______________________________
b. ______________________________
c. ______________________________
d. ______________________________
e. ______________________________
f. ______________________________

TEST

10. Identify parts of a crack-sealing machine. Write the correct numbers in the blanks.

______a. Heater exhaust

______b. Hitch

______c. Hydraulic fluid tank

______d. LPG tank

______e. Engine

______f. Loading platform

______g. Solvent tank

______h. Pump and hydraulic controls

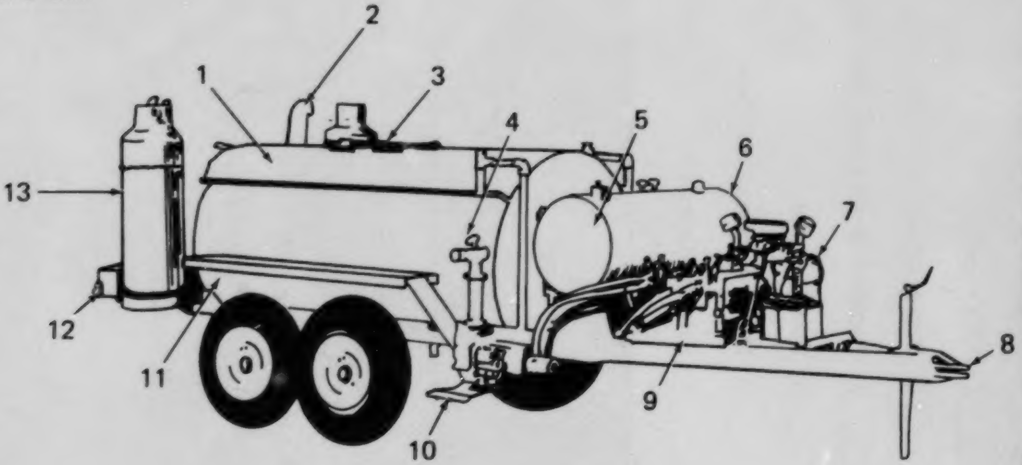
______i. Step

______j. Loading door

______k. Heater controls

______l. Heating and mixing tank

______m. Two-inch line



TEST

11. Identify controls and valves on a crack-sealing machine. Write the correct numbers in the blanks.

a. Hydraulic valves

_____1) Auger flow-control valve

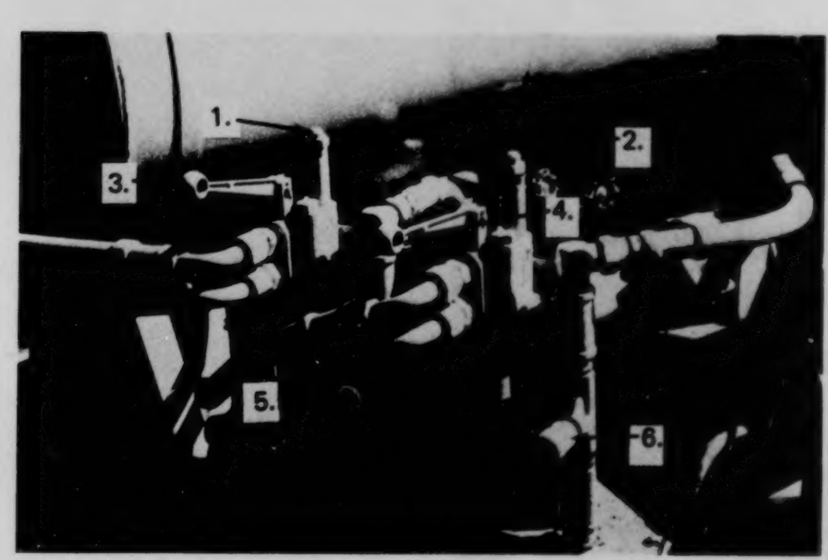
_____2) Pump pressure-release screw

_____3) Pump flow-control valve

_____4) Auger pressure-release screw

_____5) Auger valve

_____6) Pump valve



TEST

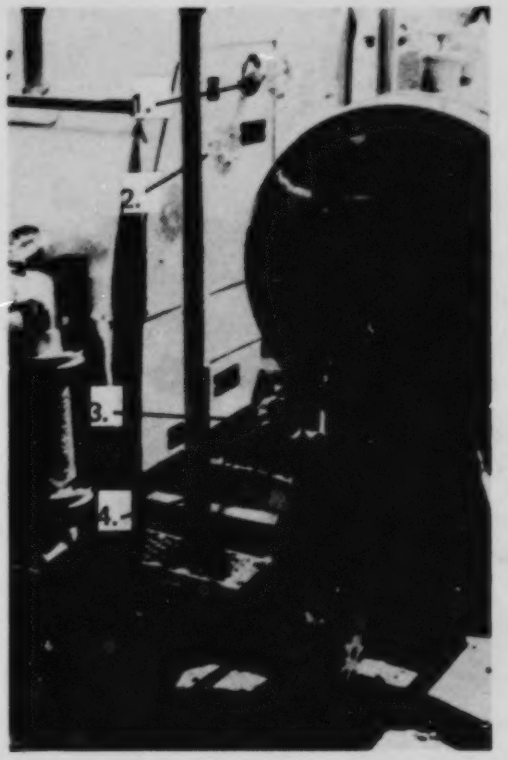
b. Front of material tank

______1) Tank valve

______2) Clean-out valve

______3) Recirculation valve

______4) Applicator valve



TEST

c. Temperature-control housing

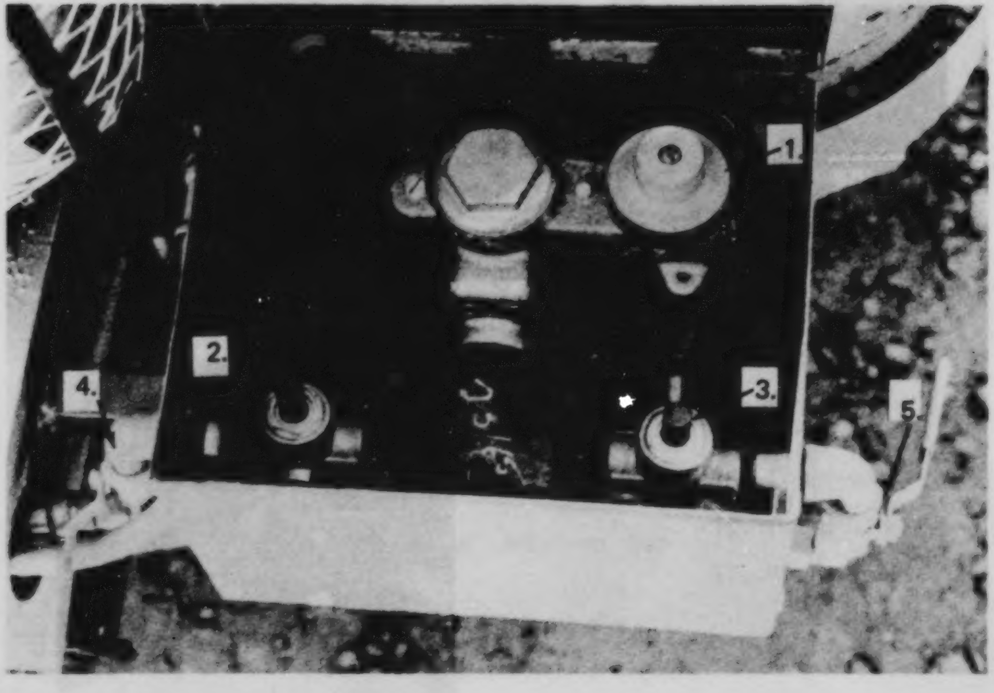
_____1) Right burner pilot button

_____2) Left main burner valve

_____3) Temperature-control valve

_____4) Right main burner valve

_____5) Left burner pilot button

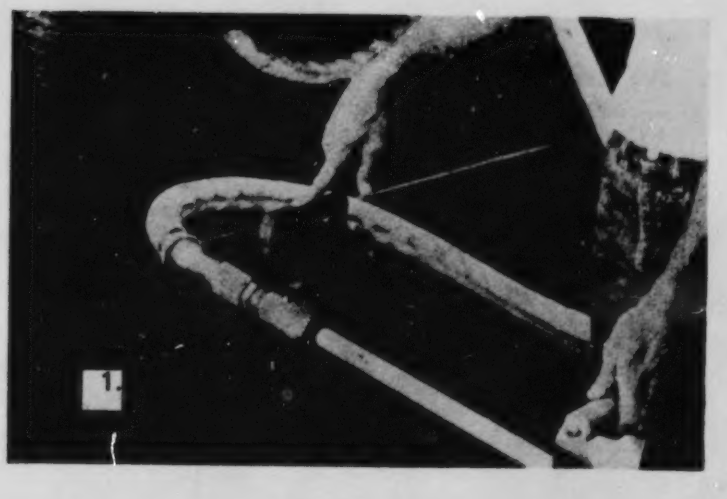


TEST

d. Other controls

______1) Hand-applicator control

______2) Drain valve



TEST

12. Match crack-sealing machine controls, valves, and gauges to their correct functions. Write the correct numbers in the blanks.

_____a. Allow flow of gas to pilot lights; located in temperature-control housing

_____b. Used to adjust pressure at all pump speeds

_____c. Used for loading machine with liquid material

_____d. Flushes system with solvent after use

_____e. Controls forward and reverse auger rotation

_____f. Controls temperature of heat-transfer oil; located in temperature-control housing

_____g. Controls gas pressure to burners; located on propane tank

_____h. Controls forward and reverse pump rotation

_____i. Register temperature of material

_____j. Used to drain solvent from lines after flushing system with solvent

_____k. Opens material tank to pump

_____l. Controls flow of hydraulic fluid to auger

_____m. Turns hand applicator on and off

_____n. Controls flow of material to hand applicator

_____o. Control flow of gas from pressure tank to burners; located on either side of temperature-control housing

_____p. Controls flow of material returning to material tank

_____q. Controls flow of hydraulic fluid to pump

1. Auger valve
2. Pressure regulator
3. Pressure-release control screws
4. Flow-control valve for pump
5. Hand-applicator valve
6. Temperature gauges
7. Recirculation valve
8. Clean-out valve
9. Temperature-control valve
10. Applicator valve
11. Two-inch line
12. Tank valve
13. Pilot buttons
14. Flow-control valve for auger
15. Drain valve
16. Pump valve
17. Main burner valves

13. State eight safety rules for operating a crack-sealing machine.

a. ____

b. ____

c. ____

d. ____

e. ____

TEST

f. ______________________________

g. ______________________________

h. ______________________________

14. Select from the following list rules for effective crack-sealing machine operation. Write an "X" in the blank before each correct answer.

a. Heating unit

_____1) Heat material to temperature specified by manufacturer

_____2) Clean machine weekly

_____3) Feed material at constant rate

_____4) Perform all prestart inspection and maintenance procedures

_____5) Maintain pump pressure at 160 psi

_____6) Feed solid material at intervals that will allow auger to rotate continuously

_____7) Keep pilot lights lit when storing machine inside overnight

_____8) Maintain pump pressure recommended by manufacturer

_____9) Preheat tank

_____10) Maintain material level at half-full

b. Hose and applicator

_____1) Heat hose and nozzle by running material through them

_____2) Hold nozzle so spray is directed straight downward

_____3) Use correct-sized and shaped nozzle for the job

_____4) Be sure connections are tight

_____5) Hold nozzle loosely for easier movement

_____6) Heat hose and nozzle in heating chamber before operation begins

_____7) Start at far end of crack

_____8) Walk backwards, holding applicator in front of you

_____9) Start at end of crack closest to crack-sealing machine

_____10) Maintain firm grip and hold steady

_____11) Clean thoroughly after each use

TEST

_____12) Start at inside of crack

_____13) Place nozzle in tank opening when not in use

_____14) Hold nozzle at an angle

(NOTE: Test questions 15 and 16 list the assignment and job sheets. They are an important part of this test. If they have not been completed, check with your instructor.)

15. Discuss safety equipment.

16. Demonstrate the ability to

    a. Perform prestart inspection and maintenance procedures on a router.

    b. Service a router.

    c. Start, warm up, operate, and shut down a router.

    d. Rout and blow cracks.

    e. Perform prestart inspection and maintenance procedures on crack-sealing machine.

    f. Service a crack-sealing machine.

    g. Light burners.

    h. Start, warm up, and operate crack-sealing machine.

    i. Shut down and clean crack-sealing machine.

CRACK-SEALING EQUIPMENT
UNIT XVII

ANSWERS TO TEST

1. a. 8
   b. 5
   c. 2
   d. 3
   e. 13
   f. 6
   g. 9
   h. 10
   i. 11
   j. 4
   k. 12
   l. 7
   m. 1

2. a, d, f, g

3. a. Router
   b. Crack-sealing machine
   c. Cutters
   d. Hand applicator

4. a. 1
   b. 2
   c. 3
   d. 3

5. a. Longitudinal and transverse cracks and construction joints
      1) 3
      2) 2
      3) 1
      4) 4
      5) 5
   b. Fatigue or "alligator" cracks
      1) 3
      2) 2
      3) 4
      4) 1

ANSWERS TO TEST

6. a. 5
   b. 8
   c. 9
   d. 12
   e. 10
   f. 4
   g. 1
   h. 11
   i. 7
   j. 3
   k. 2
   l. 6

7. a. 7
   b. 1
   c. 8
   d. 3
   e. 5
   f. 4
   g. 6
   h. 2

8. Answer should include any five of the following
   a. Read operator's manual thoroughly: know your machine
   b. Study departmental safety manual
   c. Wear protective clothing
   d. Use traffic warning devices
   e. Be sure all guards and shields are in place and in good condition
   f. Work relaxed; don't fight the machine
   g. Avoid back strain by using leverage when realigning for another approach
   h. Plan work cycle so that you work away from traffic

9. Answer should include any six of the following
   a. Perform all prestart inspection and maintenance procedures
   b. Lower cutter head until cutters slightly touch road surface
   c. On models that cut toward operator, let wear plate drag on surface
   d. Let machine propel itself; do not pull or push
   e. Operate at full trottle
   f. Use brake as required to keep machine under control

ANSWERS TO TEST

g. Operate uphill when working on grades

h. Replace cutters when they will no longer cut to desired depth

i. Rearrange or stagger cutters for wider cuts

10. a. 2

b. 8

c. 6

d. 13

e. 7

f. 11

g. 5

h. 9

i. 10

j. 3

k. 12

l. 1

m. 4

11. a. Hydraulic valves

1) 6
2) 1
3) 5
4) 2
5) 4
6) 3

b. Front of material tank

1) 3
2) 4
3) 1
4) 2

c. Temperature-control housing

1) 3
2) 4
3) 1
4) 5
5) 2

ANSWERS TO TEST

d. Other controls
    1) 1
    2) 2

12. a. 13
    b. 3
    c. 11
    d. 8
    e. 1
    f. 9
    g. 2
    h. 16
    i. 6
    j. 15
    k. 12
    l. 14
    m. 5
    n. 10
    o. 17
    p. 7
    q. 4

13. Answer should include any eight of the following
    a. Read operator's manual thoroughly: know your machine
    b. Study departmental safety manual
    c. Wear protective clothing
    d. Use traffic control devices
    e. Carry fire extinguisher
    f. Carry first-aid kit with burn-treatment supplies
    g. Use caution when adding solid material to liquid material
    h. Avoid contact with material
    i. Do not touch any part of heating unit with bare hands
    j. Make sure all couplings and connections are secure
    k. Keep hose from kinking
    l. Keep water out of heating unit
    m. Clean unit thoroughly before changing types of material
    n. Keep machine clean

ANSWERS TO TEST

14. a. Heating unit--1, 4, 6, 8, 9
    b. Hose and applicator--3, 4, 6, 7, 8, 10, 11, 13, 14

15. Evaluated to the satisfaction of the instructor

16. Performance skills evaluated to the satisfaction of the instructor

RIGGING
UNIT XVIII

UNIT OBJECTIVE

After completing this unit, the student should be able to calculate safe working loads, spreading angles, and sling stress; and be able to safely rig loads using good rigging practices. This knowledge will be shown by completing assignment sheets, job sheets, and unit test with a minimum score of 85 percent.

SPECIFIC OBJECTIVES

After completing this unit, the student should be able to

1. Match terms associated with rigging to their correct definitions.
2. Identify accessories used for load lifting.
3. Identify hitches used to attach materials and equipment to hoist.
4. Label elements of knots, bends, and hitches.
5. Match types of knots to their correct uses.
6. State safety tips related to rigging.
7. Match types of materials used in construction of ropes to their characteristics.
8. Describe general construction of rope.
9. State precautions to observe when caring for ropes.
10. Determine tensile strength of various kinds and sizes of new rope.
11. State the importance of spreading sling angles.
12. Distinguish among hand signals used in rigging operations.
13. Select from a list construction characteristics of wire rope used in rigging.
14. Match strengths of steel used in wire rope to their grades.
15. Arrange in order steps to take when performing maintenance on wire rope.
16. Label types of snatch blocks.
17. Select from a list types of cable fittings.

OBJECTIVE SHEET

18. Identify types of towing chains and accessories.
19. Select from a list good rigging practices.
20. Distinguish among types of knots.
21. Calculate safe working load (SWL) of different types and sizes of ropes.
22. Calculate sling stress.
23. Distinguish among hand signals used in rigging operations.
24. Identify bad rigging practices.
25. Demonstrate the ability to
    a. Tie knots.
    b. Install wire rope clips.
    c. Rig and handle different types of loads.

RIGGING
UNIT XVIII

SUGGESTED ACTIVITIES

I. Suggested activities

   A. Provide student with objective sheet.

   B. Provide student with information, assignment, and job sheets.

   C. Make transparencies.

   D. Discuss unit and specific objectives.

   E. Discuss information and assignment sheets.

   F. Demonstrate and discuss the procedures outlined in the job sheets.

   G. Have students purchase *Handbook for Riggers* to use for reference.
   (NOTE: See unit references.)

   H. Have students pair off and practice hand signals.

   I. Furnish students with rope to tie knots.

   J. Give test.

II. Instructional materials

   A. Objective sheet

   B. Suggested activities

   C. Information sheet

   D. Transparency masters

      1. TM #1--Elements of Knots, Bends, and Hitches
      2. TM #2--Sling Angle and Load Factors
      3. TM #3--Sling Angles
      4. TM #4--Hoist Signals
      5. TM #5--Standard Hand Signals for Boom Operation
      6. TM #6--Standard Hand Signals for Boom Operation (Continued)
      7. TM #7--Standard Hand Signals for Boom Operation (Continued)
      8. TM #8--Standard Hand Signals for Boom Operation (Continued)
      9. TM #9--Standard Hand Signals for Maneuvering Vehicles

SUGGESTED ACTIVITIES

10. TM #10--Wire Rope Fittings
11. TM #11--Wire Rope Fittings (Continued)

D. Assignment sheets

1. Assignment Sheet #1--Distinguish Among Types of Knots
2. Assignment Sheet #2--Calculate Safe Working Load (SWL) of Different Types and Sizes of Rope
3. Assignment Sheet #3--Calculate Sling Stress
4. Assignment Sheet #4--Distinguish Among Hand Signals Used in Rigging Operations
5. Assignment Sheet #5--Identify Bad Rigging Practices

E. Answers to assignment sheets

F. Job sheets

1. Job Sheet #1--Tie Knots
2. Job Sheet #2--Install Wire Rope Clips
3. Job Sheet #3--Rig and Handle Different Types of Loads

G. Test

H. Answers to test

III. Unit references

A. Hendrix, Laborn J. "Bud." *Millwright Instructional Materials.* Stillwater, Oklahoma: Oklahoma State Department of Vocational and Technical Education/Curriculum and Instructional Materials Center, and Associated General Contractors of America, 1980.

B. Newberry, W. G. (Bill). *Handbook for Riggers,* 2nd ed. Canada: Printed in Canada, ISBNO-9690154-1-0, 1977.

(NOTE: Address requests for handbook to W.G. [Bill] Newberry; P.O. Box 2999; Calgary, Alberta, Canada T2P 2M7.)

C. Nichols, Herbert L., Jr. *Heavy Equipment Repair.* Greenwich, Connecticut: North Castle Books, 1964.

D. Nichols, Herbert L., Jr. *Moving the Earth,* 3rd ed. Greenwich, Connecticut: North Castle Books, 1964.

SUGGESTED ACTIVITIES

E. Rossnagel, W. E. *Handbook of Rigging,* 3rd ed. New York: McGraw-Hill Book Company, 1964.

F. Smith, Earl L. *Power Line Technician's Training.* Stillwater, Oklahoma: Oklahoma State Department of Vocational and Technical Education/ Curriculum and Instructional Materials Center, and Rural Electric Cooperatives of Oklahoma, 1978.

RIGGING
UNIT XVIII

INFORMATION SHEET

I. Terms and definitions

A. Rigging--Setting up block and tackle to a winch, stacking and hoisting material and equipment, and/or replacing cables on equipment

B. Hitch--To attach a rope to a post, pole, ring, hook, or other object

C. Tagline--Rope used to guide and/or steady load

D. Heaved--Pulled from underneath the load

E. Tackle--Assembly of blocks and lines used to aid in lifting or pulling

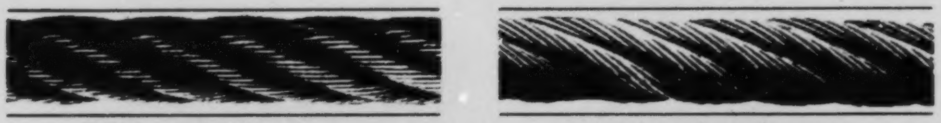
F. Sheave--Grooved wheel or pulley

G. Preforming--Preliminary shaping of wires so that they will lie in place

H. Lay--Direction, length, or angle of twist of strands in a rope or cable (Figure 1)

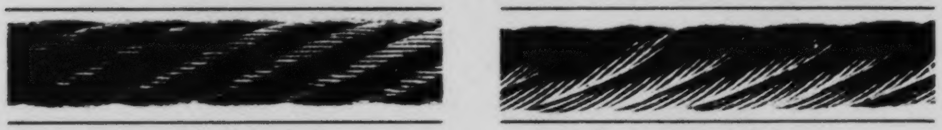
EXAMPLE:

FIGURE 1



Right, regular-lay rope

Right, Lang-lay wire rope



Left, regular-lay rope

Left, Lang-lay wire rope

Source: American Chain & Cable Co.

I. Snatch block--Pulley in a case which can be easily fastened to lines or objects by means of a hook, ring, or shackle

J. Core--Material used in center of wire rope

K. Spreader bars--Devices used to prevent crushing of load and to lift extra long or heavy loads

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L. psi--Pounds per square inch

M. Center of gravity--Point at which entire weight is concentrated

N. Eye--Metal loop which engages a hook

O. Thimble--Grooved metal ring inserted in loop of rope to prevent wear

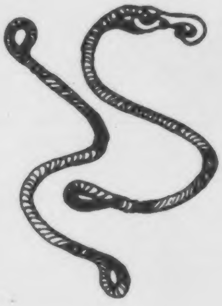
P. Dog--Slang meaning to deliberately slow down the work pace

Q. Splice--To join two parts of a rope or wire to form a continuous length

II. Accessories used for load lifting (Figures 2-8)

A. Chokers (single slings)

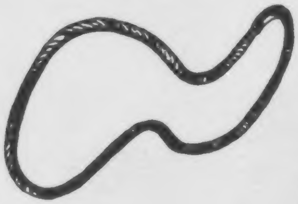
FIGURE 2



B. Grommet sling

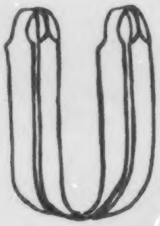
(NOTE: A chain such as this is called an endless chain.)

FIGURE 3



C. Web sling

FIGURE 4



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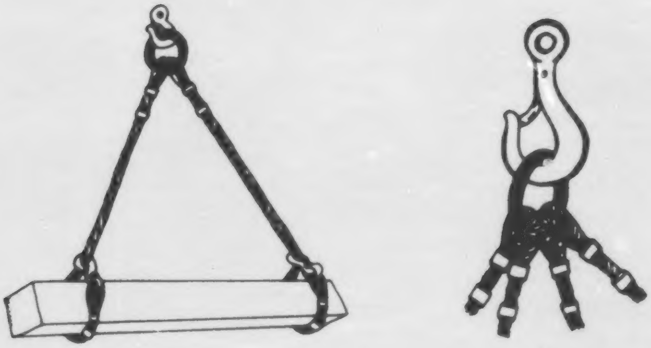
D. Bridles

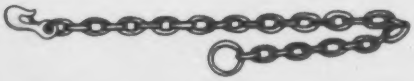
FIGURE 5



E. Bull chain

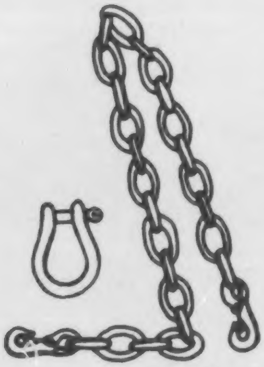
(NOTE: Chains are used mainly for towing and for securing equipment.)

FIGURE 6



F. Chain and shackle

FIGURE 7



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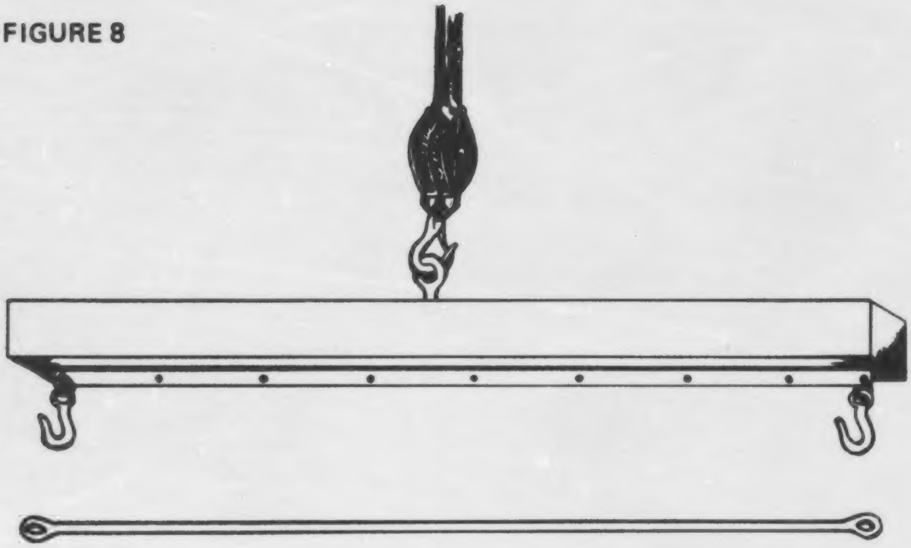
G. Spreader bars

FIGURE 8

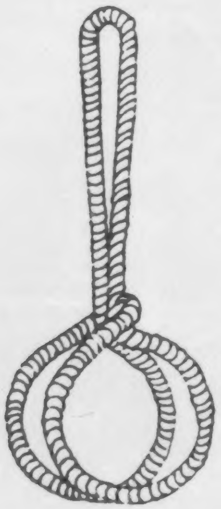


III. Hitches used to attach materials and equipment to hoist (Figures 9-13)

(CAUTION: The placement of hitches on the load is very critical. Make sure that hitches are made secure and safe.)

A. Choker hitch sling

FIGURE 9



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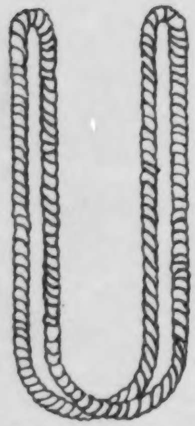
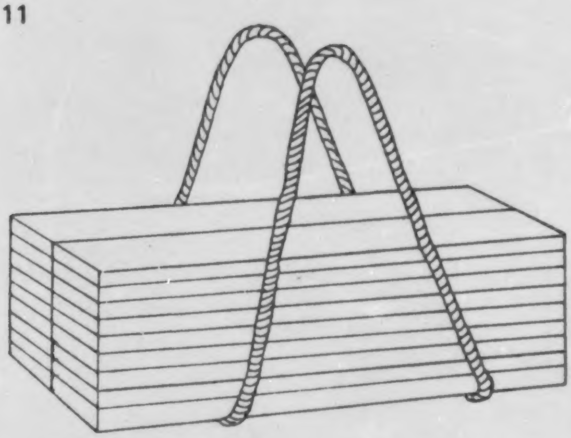
B. Basket hitch sling

FIGURE 10



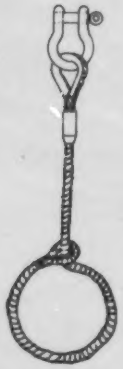
C. Inverted basket hitch sling

FIGURE 11



D. Choker hitch choker

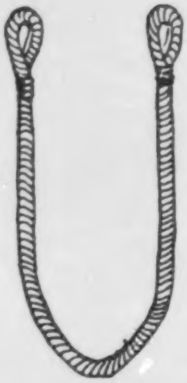
FIGURE 12



INFORMATION SHEET

E. Basket hitch choker

FIGURE 13



IV. Elements of knots, bends, and hitches (Transparency #1)

- A. Bight
- B. Overhand loop
- C. Underhand loop
- D. Running end
- E. Whipping
- F. Round turn
- G. Turn
- H. Standing part

V. Types of knots and their correct uses (Assignment Sheet #1; Job Sheet #1)

(NOTE: Efficiency of manila rope decreases considerably when using knots and splices.)

EXAMPLE:

Straight rope = 100% strength

Eye splice = 85% strength

Clove hitch = 75% strength

Bowline = 53% strength

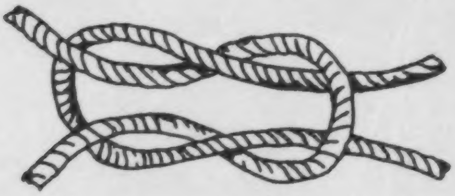
Square knot = 43% strength

Sheepshank = 35% strength

INFORMATION SHEET

A. Square knot–Ties two lines of equal size together so that they will not slip (Figure 14)

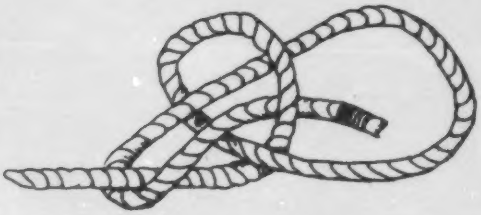
FIGURE 14



B. Bowline--Forms a single loop that will not tighten or slip under strain (Figure 15)

(NOTE: This is one of the best knots to use to lower people or materials.)

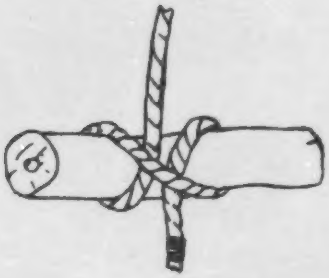
FIGURE 15



C. Clove hitch--Fastens a line to timber or pipe (Figure 16)

(NOTE: This is probably one of the most widely used knots.)

FIGURE 16

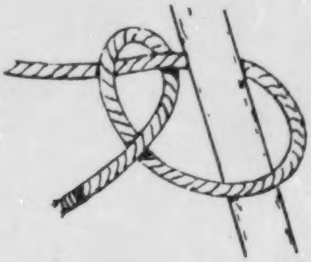


INFORMATION SHEET

D. Half hitch--Ties line to timber or to a larger line (Figure 17)

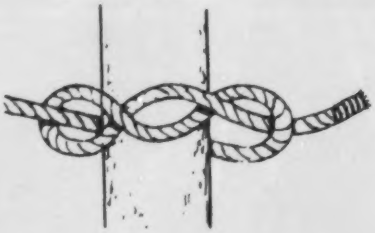
(NOTE: This is a quick and easy knot to use when tying down a tarp or plastic covering.)

FIGURE 17



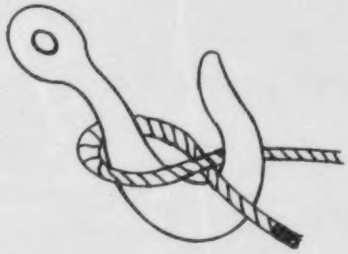
E. Timber hitch--Holds timber securely when moving heavy timber or poles because of the pressure of one coil over other; the more tension applied, the tighter the hitch (Figure 18)

FIGURE 18



F. Blackwall hitch--Fastens a line to a hook; generally used temporarily (Figure 19)

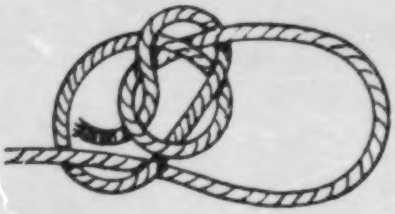
FIGURE 19



INFORMATION SHEET

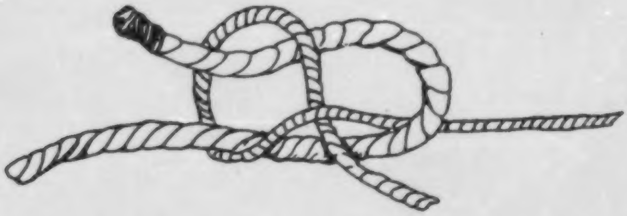
G. Running bowline--Forms a strong running loop which is convenient for running an eye; can also provide a choker-type sling at the end of a line (Figure 20)

FIGURE 20



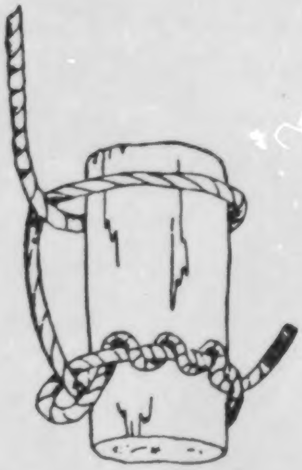
H. Sheet bend--Ties two lines of unequal size together; also used to tie a line to an eye (Figure 21)

FIGURE 21



I. Timber hitch with half hitch--Holds heavy timbers or poles for lifting or dragging (Figure 22)

FIGURE 22



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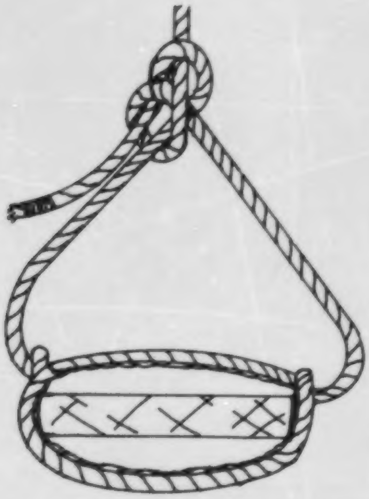
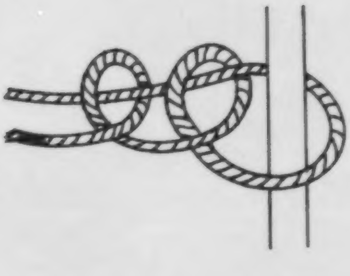
J. Scaffold hitch--Supports ends of scaffold plank and prevents it from tilting (Figure 23)

FIGURE 23



K. Two half hitches--Secures the running end of a line to the standing part (Figure 24)

FIGURE 24



VI. Safety tips related to rigging (Job Sheet #3)

A. Use personal protective devices such as goggles, gloves, safety shoes, and hard hats

B. Use tagline to guide and/or steady load

C. Do not walk under load

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D. Be sure load is balanced properly

E. Do not overload equipment

F. Use corner saddles, padding, or wood blocking to protect slings from sharp bends and sharp edges

G. Stand clear when slings are heaved from under loads

H. Be sure outriggers and/or stabilizers are in use and are on solid footing

I. Lubricate slings to prevent rust

J. Be sure all hooks have safety snaps

K. Be extra cautious around power lines

(CAUTION: A minimum of ten feet between equipment and power lines is required. Check local requirements.)

L. Be sure there are enough people to hold tagline for heavy loads

VII. Types of materials used in construction of ropes and their characteristics

A. Natural fibers

1. Manila--Strong and durable; used where dependability, ability to stand up under severe use, and weathering are required

2. Sisal--Less durable, lower in strength; used where requirements are less demanding and low cost is a major factor

B. Synthetic ropes

1. Nylon--Very strong, approximately twice the strength of manila; unusually high abrasion resistance, good resistance to weathering, and high degree of stretch

2. Terylene--Quite similar to nylon except somewhat lower in tensile strength and having much less stretch

3. Polypropylene--Slightly less strength than nylon, but a degree of stretch similar to terylene; very light, actually floats on water, and is resistant to rot

4. Polyethylene--Has about same strength as polypropylene, but has a high stretch factor and excellent resistance to mildew, decay, acids, and alkalies

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VIII. General construction of rope

A. Rope is normally made of three strands, each of which is made of several threads

B. The rope itself is twisted in a right-hand direction while each strand is twisted in a left-hand direction and the individual threads are twisted in a right-hand direction

C. Reversal of twist in strands gives the rope a balance or set which eliminates the tendency to unwind

IX. Precautions to observe when caring for ropes

A. When taking rope from a coil, always remove it from the center in a counterclockwise direction

B. When rope is not in use, it should be re-coiled in a clockwise direction

C. When rope is attached to a hook, ring, or pully block, a thimble should be placed in the loop or eye to reduce wear and to decrease stress

D. Protect rope from moisture and weather as much as possible

E. Do not disturb a frozen rope until completely thawed

F. Keep rope away from acids, other chemicals, and heat

G. Do not drag rope over ground or sharp edges

H. If possible, do not make abrupt bends in rope

I. Wash and dry dirty rope before storing it

J. Store rope so that air can circulate around it

(NOTE: Hang rope in loose coils or place on wood grating above the floor.)

K. If manila rope becomes stiff and hard because of being wet, treat with a thin lubricating oil or warm petrolatum

(NOTE: Petrolatum is a jelly-like petroleum based dressing that can be applied with a paint brush.)

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X. Tensile strength of various kinds and sizes of new rope (Assignment Sheet #2)

(NOTE: Tensile strength and working load decrease with wear.)

Diameter	Manila	Nylon	Dacron	Poly-ethylene	Poly-propylene
3/16"	450	960	720	700	740
1/4"	600	1,500	1,150	1,200	1,250
5/16"	1,000	2,400	1,750	1,750	1,900
3/8"	1,350	3,400	2,450	2,500	2,700
7/16"	1,750	4,800	3,400	3,400	3,550
1/2"	2,650	6,200	4,400	4,100	4,500
9/16"	3,450	8,000	5,700	5,100	5,400
5/8"	4,400	10,000	7,300	6,000	6,600
3/4"	5,400	14,000	10,000	7,500	8,000
7/8"	7,700	19,000	13,600	9,900	10,750
1"	9,000	24,000	16,500	11,000	12,500
1 1/8"	12,000	31,500	21,600	15,000	17,000
1 1/4"	13,500	36,000	24,400	17,300	19,500

XI. Importance of spreading sling angles (Figure 25; Transparencies #2 and #3)

A. Changing angle of sling leg may increase the stress on the sling

B. As angle is reduced, lifting capacity is reduced very rapidly

C. When single leg of sling is at 60° angle, lifting capacity is only 87 percent of a vertical leg

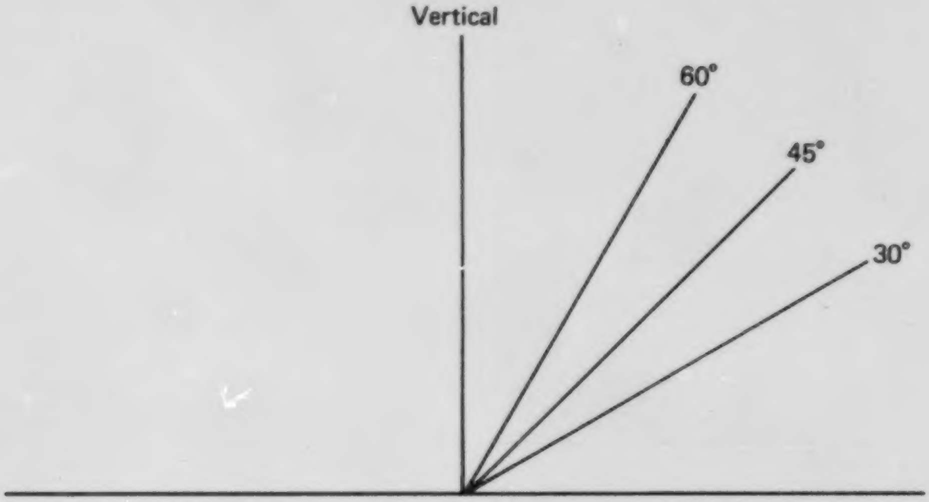
D. When single leg of sling is at 45° angle, lifting capacity is 71 percent of a vertical leg

INFORMATION SHEET

E. When single leg of sling is at 30° angle, lifting capacity is only 50 percent of a vertical leg (Figure 25)

EXAMPLE:

FIGURE 25



XII. Hand signals used in rigging operations (Transparencies #4-#9; Assignment Sheet #4)

(NOTE: Operators must become proficient in identifying and giving these hand signals.)

A. Hoist operation

1. Hoist load
2. Lower load
3. Stop
4. Emergency stop

B. Boom operation

1. Hoist
2. Lower
3. Use main hoist

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    4. Use whipline
    5. Raise boom
    6. Lower boom
    7. Move slowly
    8. Raise boom and lower load
    9. Lower boom and raise load
    10. Swing
    11. Stop
    12. Emergency stop
    13. Travel
    14. Dog everything
    15. Travel (both tracks)
    16. Travel (one track)
    17. Extend boom
    18. Retract boom

C. Maneuvering vehicles

    1. Direction of motion
    2. Turn while moving
    3. Straighten out
    4. Stop

Construction characteristics of wire rope used in rigging (Figure 26)

A. Size of wire in strand

B. Grade of steel wire used

C. Number of wires in each strand

D. Number of strands

E. Type of core

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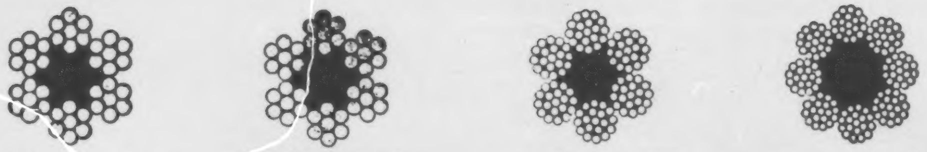
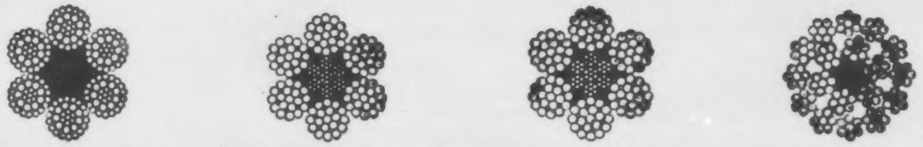
F. Preformed lay

EXAMPLES:

FIGURE 26



1. 6 x 7 coarse laid
2. 6 x 19 Seale
3. 6 x 19 modified Seale
4. 8 x 19 modified Seale



5. 6 x 37 extra pliable
6. 6 x 19 modified Seale with independent wire rope core, Lang-lay
7. 6 x 19 regular lay with independent wire rope center
8. 8 x 7 nonrotating

XIV. Strengths of steel used in wire rope and their grades

A. Iron wire--100,000 psi

B. Traction steel--180,000 to 190,000 psi

C. Mild plow steel--200,000 to 220,000 psi

D. Plow steel--220,000 to 240,000 psi

E. Improved plow steel--240,000 to 260,000 psi

XV. Steps to take when performing maintenance on wire rope

(NOTE: Frequent application of proper lubricant to exterior of rope is necessary to help retain lubricant within the rope.)

A. Check for frayed and/or worn wires

B. Heat oil that is recommended by manufacturer

(NOTE: Apply oil while thin so that it will penetrate into center of rope.)

C. Apply oil by moving rope through a long pan

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D. Wipe off surplus oil as rope leaves pan

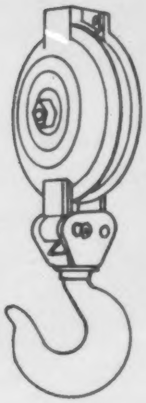
E. Let cool and thicken

XVI. Types of snatch blocks (Figures 27-32)

(NOTE: Snatch blocks are used to increase the force exerted by a line when hoisting and dragging.)

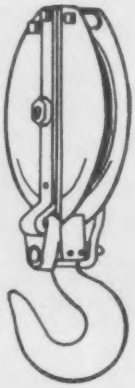
A. Swivel hook

FIGURE 27



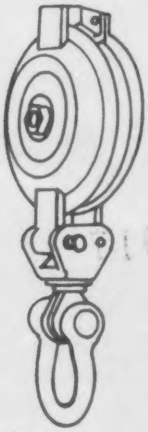
B. Self locking

FIGURE 28



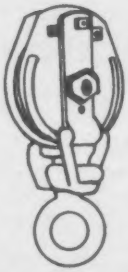
C. Swivel shackle

FIGURE 29



D. Swivel eye

FIGURE 30



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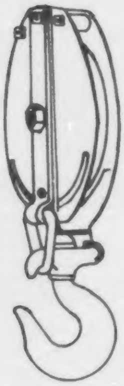
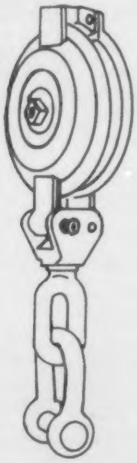
E. Drop link

FIGURE 31



F. Upset swivel shackle

FIGURE 32



XVII. Types of cable fittings (Transparencies #10 and #11; Job Sheet #2)

A. Standard solid thimble

B. Standard hawser thimble

C. Drop forged clip

D. Open wedge socket

E. Open socket for flat rope

F. Closed socket for flat rope

G. Closed-type bridge socket

H. Open-type bridge socket

I. Swaged clevis fitting

J. Swaged round eye fitting

K. Swivel eye and socket

L. Screw pin shackle

M. Standard shackle

N. Turnbuckle with spliced rope

O. Turnbuckle with socketed rope

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P. Turnbuckle with clipped rope

Q. Drop forged steel hook with thimble

R. Drop forged steel hook with shank

S. Drop forged steel hook with eye

T. Safety snap hook

U. Reversed eye hook

V. Drop forged steel swivel hook and socket

W. Logging swivel hook and socket with double swivel

X. Swivel eye socket with chain

Y. Closed socket with chain

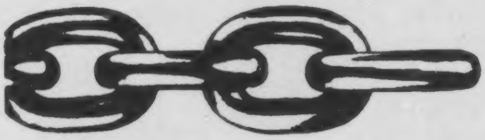
XVIII. Types of towing chains and accessories (Figures 33-42)

(NOTE: Chain is made in a variety of sizes, strengths, and designs; size is designated by diameter of bar used to make links, and ranges in size from 1/4 inch to 2 inches.)

A. Chains

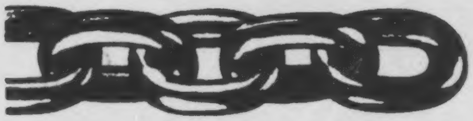
1. Proof chain

FIGURE 33



2. BBB chain

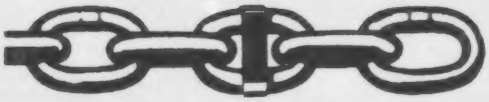
FIGURE 34



INFORMATION SHEET

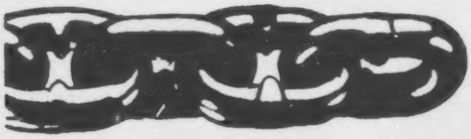
3. High test chain

FIGURE 35



4. Alloy chain

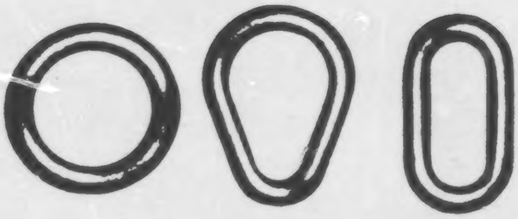
FIGURE 36



B. Accessories

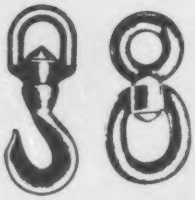
1. Rings

FIGURE 37



2. Swivels

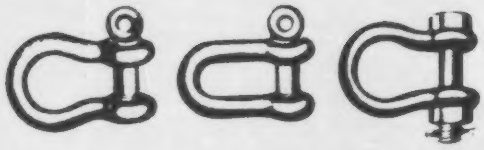
FIGURE 38



INFORMATION SHEET

3. Shackles

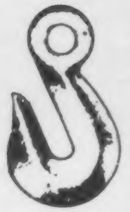
FIGURE 39



4. Hooks

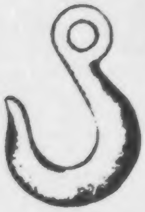
   a. Grab hook

FIGURE 40



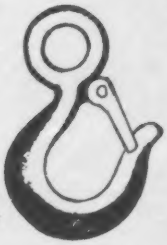
   b. Slip hook

FIGURE 41



   c. Safety hook

FIGURE 42



INFORMATION SHEET

XIX. Good rigging practices (Assignment Sheets #3-#5; Job Sheet #3)

A Turn hooks out

B Use shackles on chokers where there may be cutting action

C. Pad all sharp corners and edges

D. Always make vertical lifts on eye bolts

(NOTE: Lifting at an angle reduces safe load as much as 90 percent.)

E. Use a thimble in eye splices

F. Use a shackle whenever two or more ropes are to be used over a hook

G. Use tagline to control loads

H. Secure all unused sling lines

I. Never wrap a rope around a hook

J. Do not permit bending of rope near a splice or attached fitting

K. Block all loads properly before unhooking

L. Never allow a shackle to be pulled at an angle

(NOTE: Use washers for packing if necessary.)

M. Do not use screw pin shackle if the pin can roll under load and unscrew

N. Center crane over load before lifting

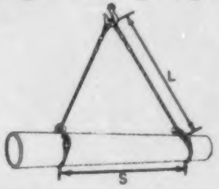
O. Give all hand signals clearly and correctly

P. Keep machines at least 10 feet from all electrical equipment

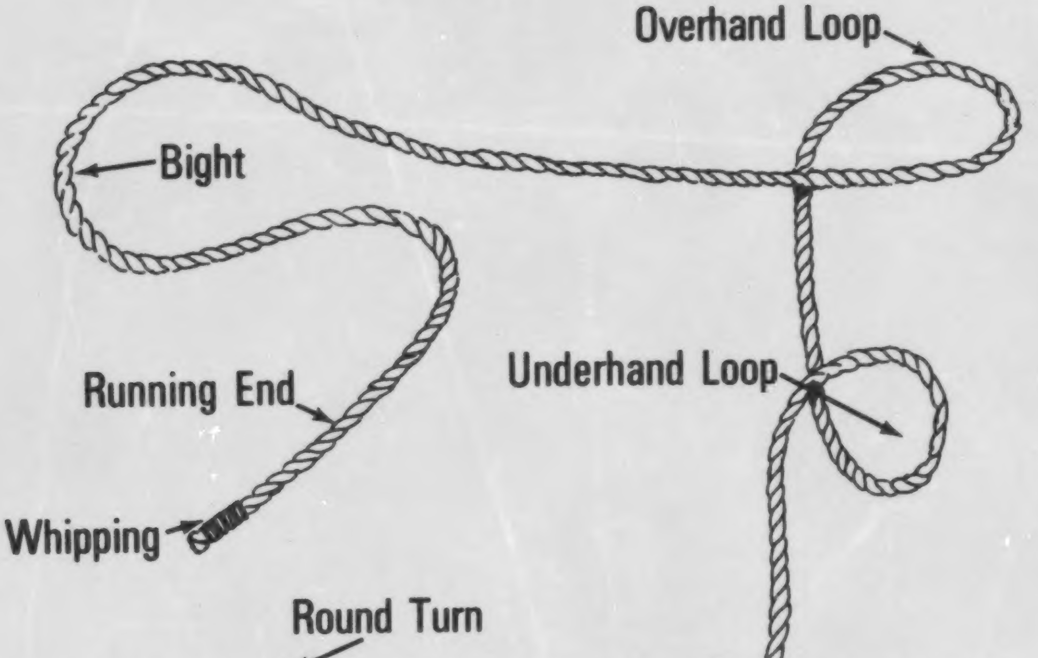
Q. For proper sling angle, be sure length of slings is always greater than the span between the two connections (Figure 43)

EXAMPLE: L (length of sling) is greater than S (span)

FIGURE 43



Elements of Knots, Bends, and Hitches


Overhand Loop
Bight
Running End
Underhand Loop
Whipping
Round Turn
Turn
Standing Part
Rope or Line

Sling Angle and Load Factors

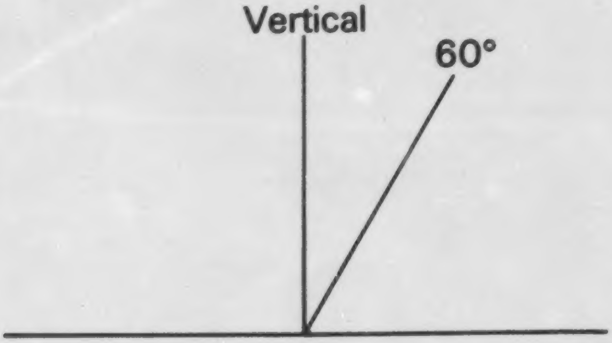
Sling Angle	Load Angle Factor
0 (Vertical)	1.000
15°	1.035
20°	1.064
25°	1.104
30°	1.155
35°	1.221
40°	1.305
45°	1.414
50°	1.555
55°	1.742
60°	2.000

Sling Angles

Critical Angle--Sling Angle that Exists when the Tension in the Sling Leg Equals the Weight of the Load

Critical Angle Formula

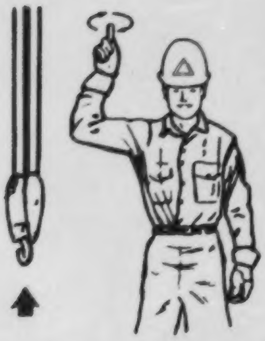
$$CA = \frac{60°}{N}$$



N = Number of Sling Legs

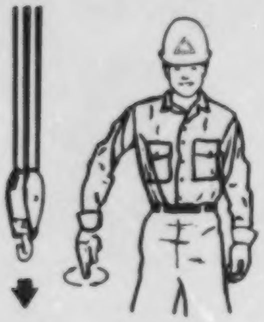
Hoist Signals

Hoist the Load



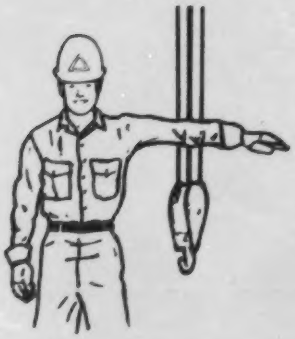
Forearm vertical, forefinger pointing up, move hand in small, horizontal circle

Lower the Load



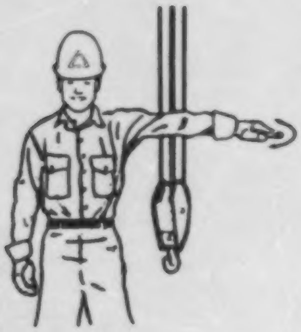
Arm extended downward, forefinger pointing down, move hand in small, horizontal circle

Stop



Arm extended, palm down, hold position rigidly

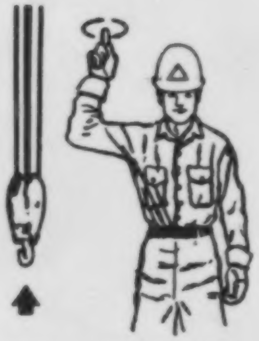
Emergency Stop



Arm extended, palm down, move hand rapidly right and left

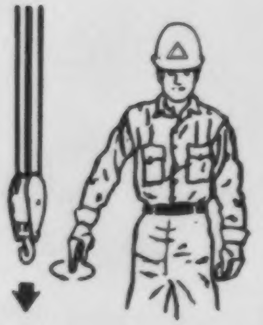
Standard Hand Signals for Boom Operation

Hoist



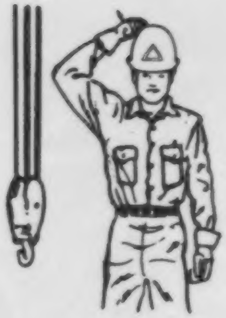
Forearm vertical, forefinger pointing up, move hand in small, horizontal circle

Lower



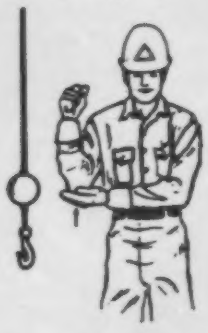
Arm extended downward, forefinger pointing down, move hand in small horizontal circles

Use Main Hoist



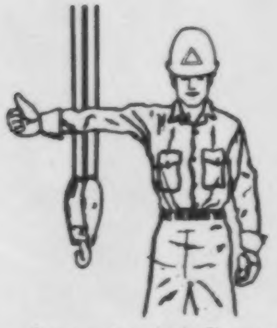
Tap fist on head then use regular signals

Use Whipline



Tap elbow with one hand: then use regular signals

Raise Boom

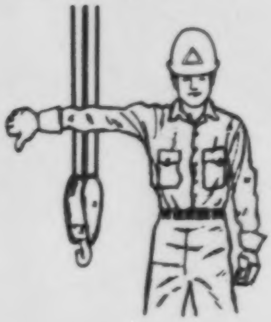


Arm extended, fingers closed, thumb pointing upward

Standard Hand Signals for Boom Operation

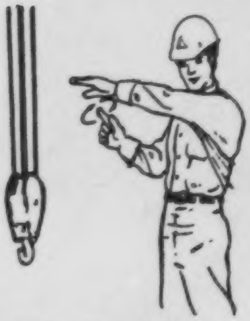
(Continued)

Lower Boom



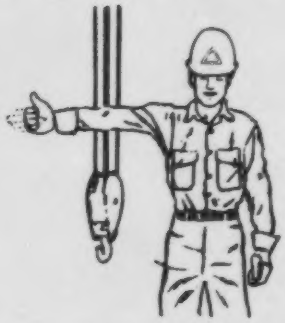
Arm extended, fingers closed, thumb pointing downward

Move Slowly



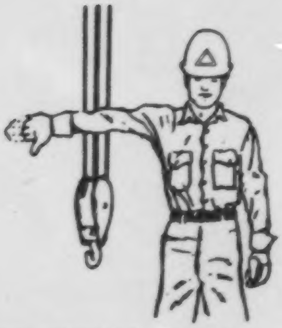
Use one hand to give any motion signal and place other hand motionless in front of hand giving the motion signal (hoist slowly shown as example)

Raise the Boom and Lower the Load



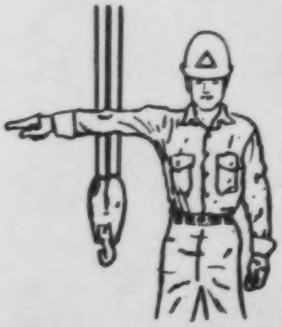
Arm extended, thumb pointing up, flex fingers in and out as long as load movement is desired

Lower the Boom and Raise the Load



Arm extended, thumb pointing down, flex fingers in and out as long as load movement is desired

Swing

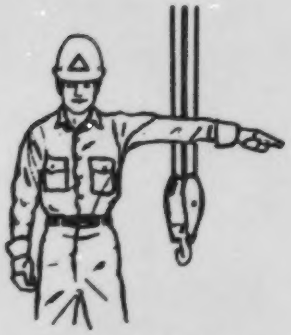


Arm extended, point with finger in direction of swing of boom

Standard Hand Signals for Boom Operation

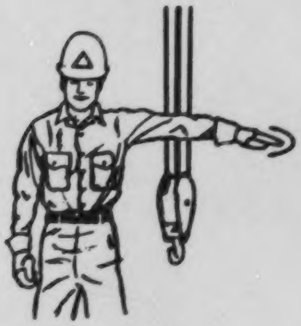
(Continued)

Stop



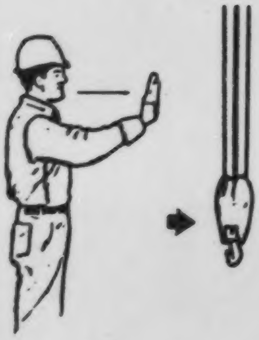
Arm extended, palm down hold position rigidly

Emergency Stop



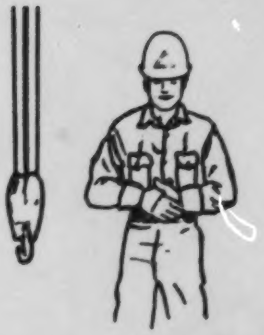
Arm extended, palm down, move hand rapidly right and left

Travel



Arm extended forward, hand open and slightly raised, make pushing motion in direction of travel

Dog Everything

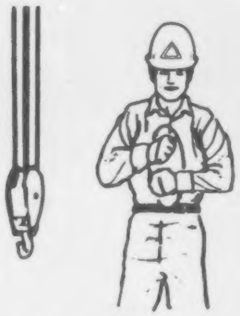


Clasp hands in front of body

Standard Hand Signals for Boom Operation

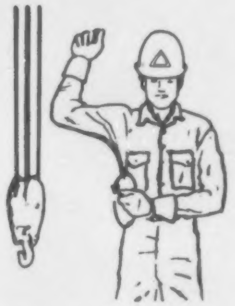
(Continued)

Travel (both tracks)



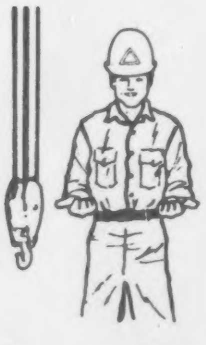
Use both fists in front of body, making a circular motion about each other indicating direction of travel: forward or backward (crawler cranes only)

Travel (one track)



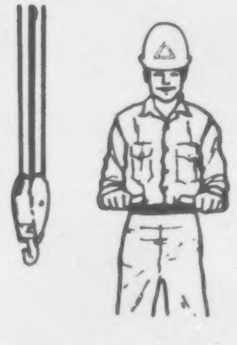
Lock the track on side indicated by raised fist, travel opposite track in direction indicated by circular motion of other fist, rotated vertically in front of body (for crawler cranes only)

Extend Boom



Both fists in front of body with thumbs pointing outward

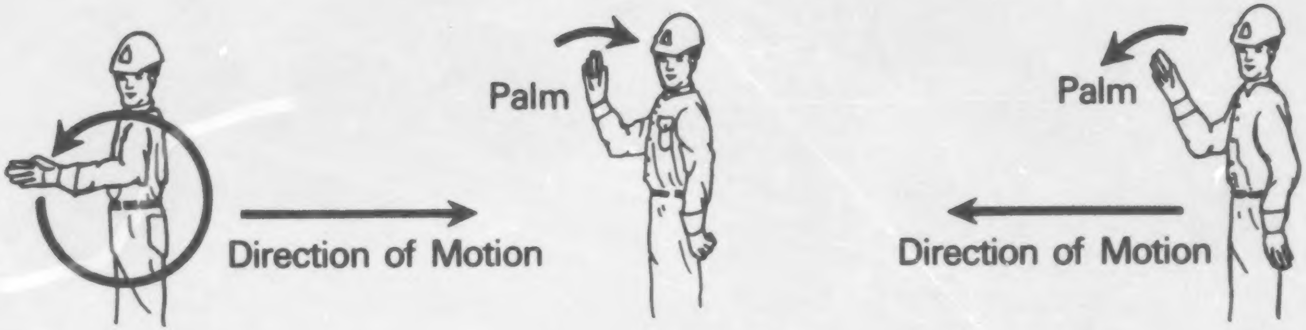
Retract Boom



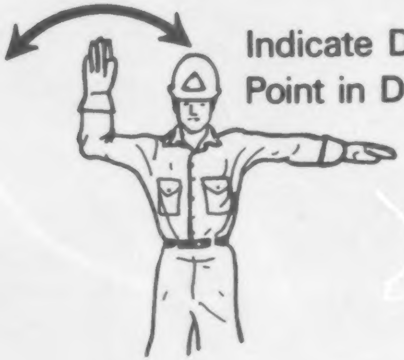
Both fists in front of body with thumbs pointing toward each other

Standard Hand Signals for Maneuvering Vehicles

Move

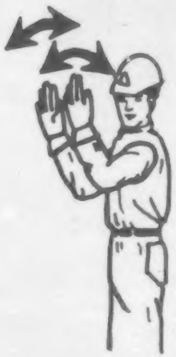

Palm
Direction of Motion
Palm
Direction of Motion

Turn While Moving

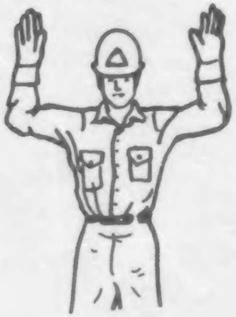


Indicate Direction
Point in Direction of Turn

Straighten Out



Stop



TM #9

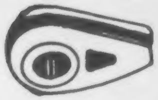
930

931

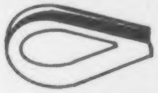
DOT II - 1007

Wire Rope Fittings

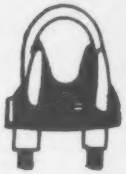
Standard Solid Thimble



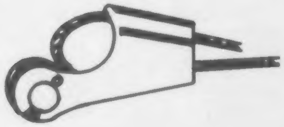
Standard Hawser Thimble



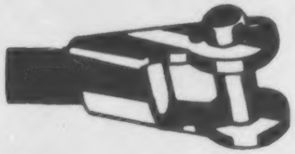
Drop Forged Clip



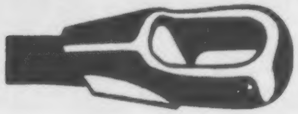
Open Wedge Socket



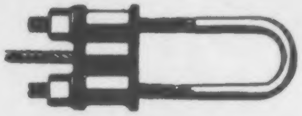
Open Socket for Flat Rope



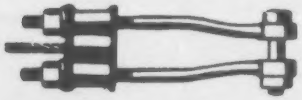
Closed Socket for Flat Rope



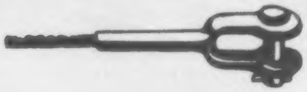
Closed-type Bridge Socket



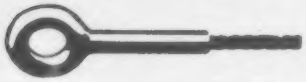
Open-type Bridge Socket



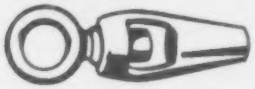
Swaged Clevis Fitting



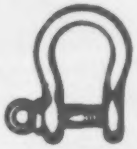
Swaged Round Eye Fitting



Swivel Eye and Socket



Screw Pin Shackle



TM #10

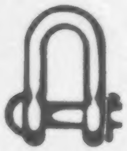
932

933

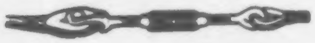
DOT II - 1009

Wire Rope Fittings
(Continued)

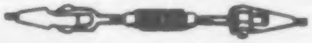
Standard Shackle



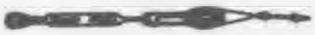
Turnbuckle with Spliced Rope



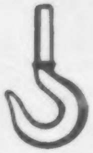
Turnbuckle with Socketed Rope



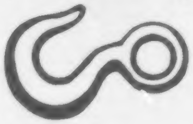
Turnbuckle with Clipped Rope



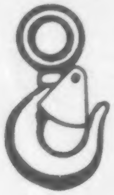
Drop Forged Steel Hook with Shank



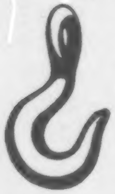
Drop Forged Steel Hook with Eye



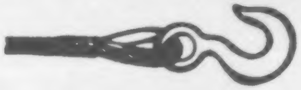
Safety Snap Hook



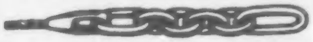
Reversed Eye Hook



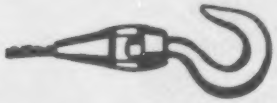
Drop Forged Steel Hook with Thimble



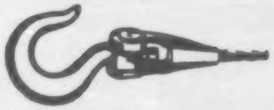
Closed Socket with Chain



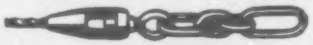
Drop Forged Steel Swivel Hook and Socket



Logging Swivel Hook and Socket with Double Swivel



Swivel Eye Socket with Chain



RIGGING
UNIT XVIII

ASSIGNMENT SHEET #1--DISTINGUISH AMONG TYPES OF KNOTS

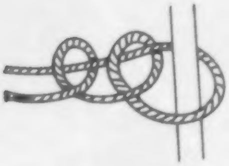
NAME ______________________________ SCORE ______________

A good knot should be easy to tie, should hold without slipping, and should be easy to untie. These particular knots were chosen because of the jobs for which they will be used.

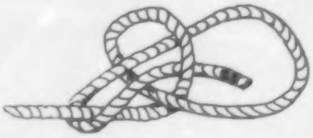
PART I

Distinguish among types of knots by writing an "X" in the blanks under the correct illustrations.

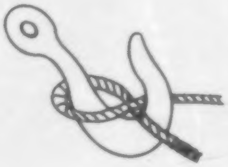
A. Bowline



1. ______________

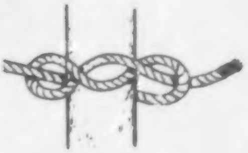


2. ______________

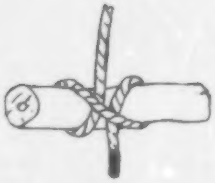


3. ______________

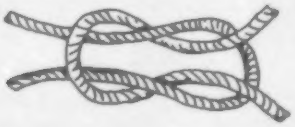
B. Square knot



1. ______________

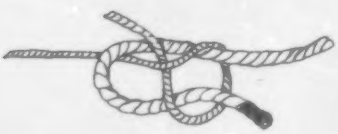


2. ______________

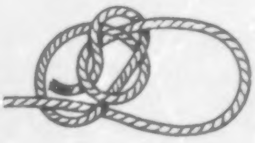


3. ______________

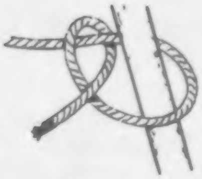
C. Sheet bend



1. ______________



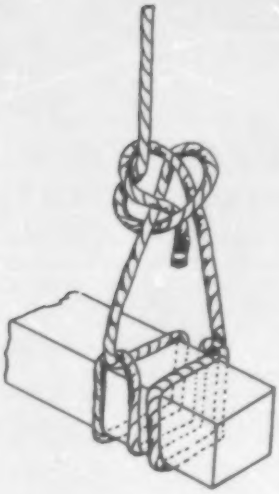
2. ______________

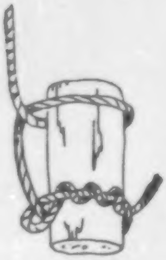


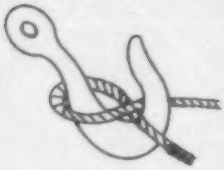
3. ______________

ASSIGNMENT SHEET #1

D. Timber hitch with half hitch







1. ______________ 2. ______________ 3. ________________

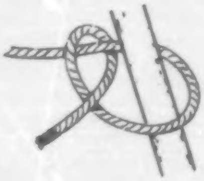
PART II

Write an "X" in the blank before the correct description of each illustration.

E. _____1. Timber hitch

_____2. Blackwall hitch

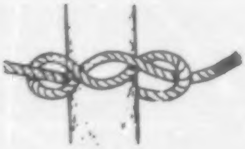
_____3. Half hitch



F. _____1. Clove hitch

_____2. Timber hitch

_____3. Square knot

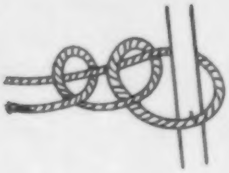


ASSIGNMENT SHEET #1

G. _____1. Two half hitches

_____2. Sheet bend

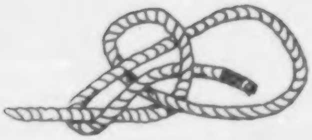
_____3. Scaffold hitch



H. _____1. Square knot

_____2. Bowline

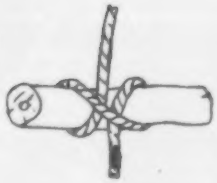
_____3. Clove hitch



I. _____1. Timber hitch with half hitch

_____2. Clove hitch

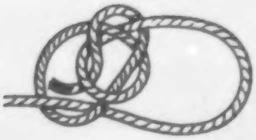
_____3. Blackwall hitch



J. _____1. Bowline

_____2. Half hitch

_____3. Running bowline



RIGGING
UNIT XVIII

ASSIGNMENT SHEET #2--CALCULATE SAFE WORKING LOAD (SWL) OF DIFFERENT TYPES AND SIZES OF ROPES

NAME ______________________________ SCORE ____________

The safe working load is the load that can be applied to new rope. The tensile strength and working load decrease with wear.

Calculate safe working load (SWL) of different types and sizes of ropes.

Formula: Tensile strength ÷ safety factor = working load

EXAMPLE:

Type of Rope	Tensile Strength	Safety Factor	Working Load
1/2" nylon	6200 pounds	5	1240 pounds
1/2" polypropylene	4500 pounds	5	900 pounds
1/2" dacron	4400 pounds	5	880 pounds
1/2" polyethylene	4100 pounds	5	820 pounds
1/2" manila	2650 pounds	5	530 pounds

A. 1-inch nylon rope with 24,000 pounds tensile strength

Safe working load = ______________________________

B. 1/4-inch polypropylene rope with 1,250 pounds tensile strength

Safe working load = ______________________________

ASSIGNMENT SHEET #2

C. 5/8-inch dacron rope with 7,300 pounds tensile strength

Safe working load = ____________________

D. 3/4-inch polyethylene rope with 7,500 pounds tensile strength

Safe working load = ____________________

E. 3/8-inch manila rope with 1,350 pounds tensile strength

Safe working load = ____________________

F. 3/8-inch nylon rope with 3,400 pounds tensile strength

Safe working load = ____________________

RIGGING
UNIT XVIII

ASSIGNMENT SHEET #3--CALCULATE SLING STRESS

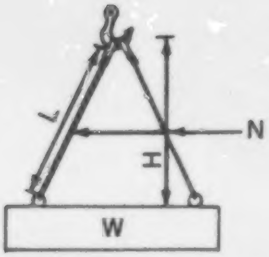
NAME ______________________________ SCORE ______________

Formula for calculating sling stress

$\frac{W \times L}{H \times N} = S$

W = Weight of load
L = Length of sling
H = Height of load
N = Number of sling legs

EXAMPLE:



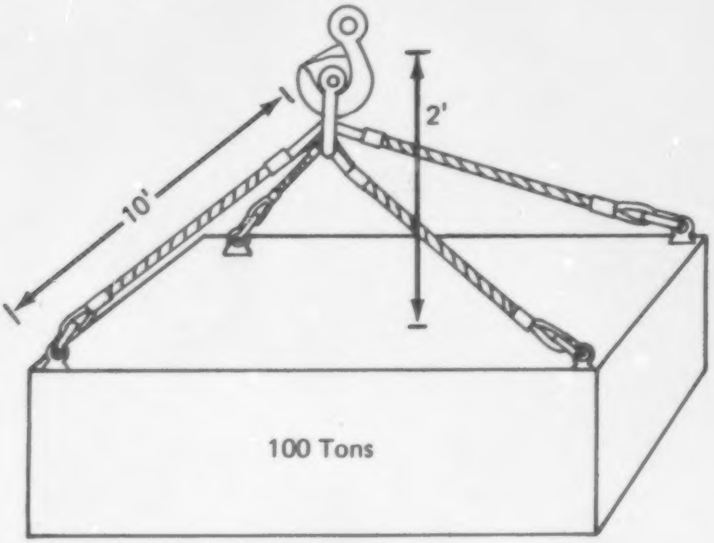
W = 10
L = 3
H = 2
N = 2

$\frac{10 \times 3}{2 \times 2} = \frac{30}{4} = 7\ 1/2$

Stress = 7 1/2 tons each sling

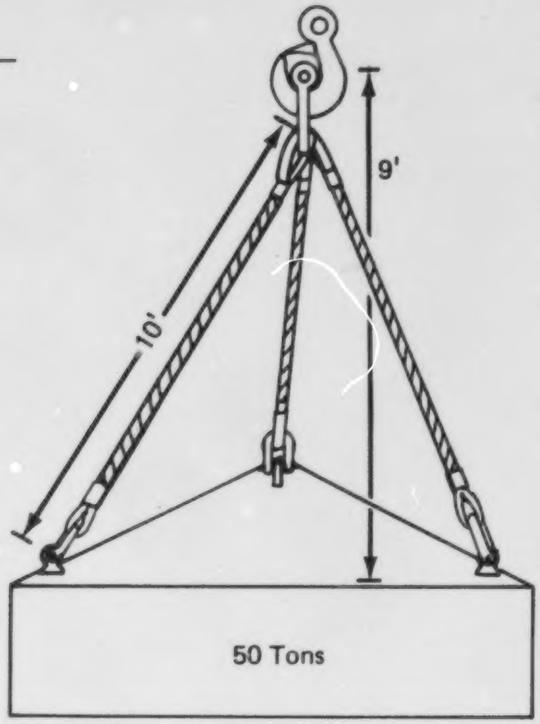
Calculate sling stress for the following illustrations.

A. Sling stress = ______________

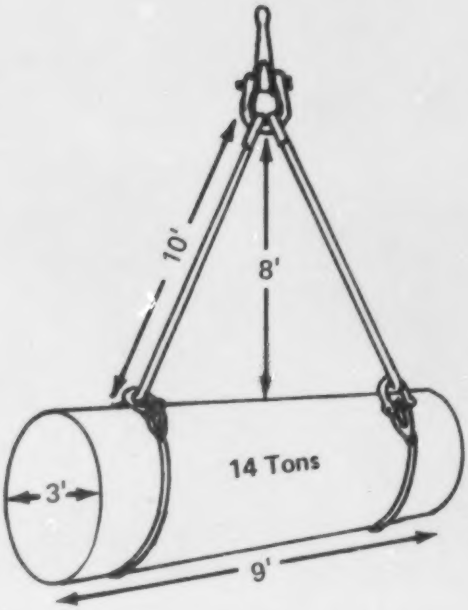


ASSIGNMENT SHEET #3

B. Sling stress = ______________

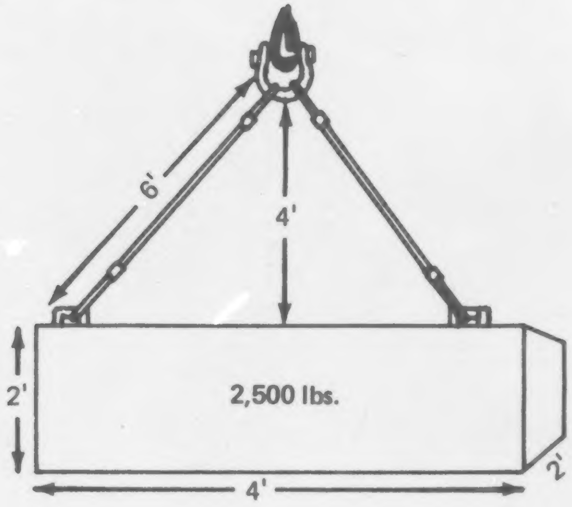


C. Sling stress = ______________

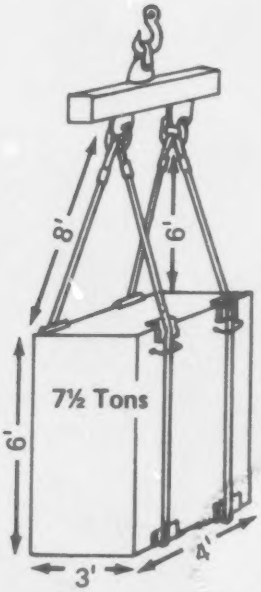

10'
8'
14 Tons
3'
9'

ASSIGNMENT SHEET #3

D. Sling stress = ____________


6'
4'
2'
2,500 lbs.
4'
2'

E. Sling stress = ____________


8'
6'
7½ Tons
6'
3'
4'

RIGGING
UNIT XVIII

ASSIGNMENT SHEET #4--DISTINGUISH AMONG HAND SIGNALS USED IN RIGGING OPERATIONS

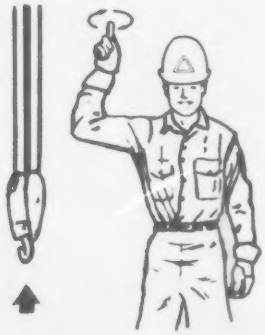
NAME ______________________________ SCORE ______________

In all rigging operations it is very important to know how to use hand signals; by knowing them you may be able to help another worker get out of a bad situation and possibly avoid a serious accident.

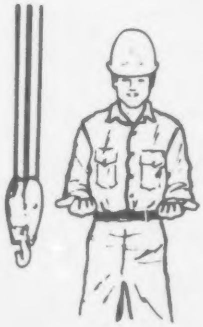
PART I

Distinguish among hand signals by writing an "X" under the correct illustrations.

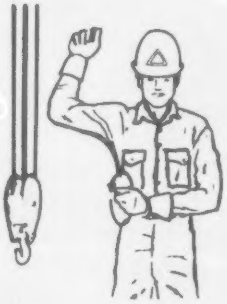
A. Hoist load



1. ______________

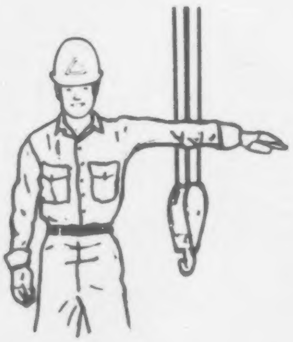


2. ______________

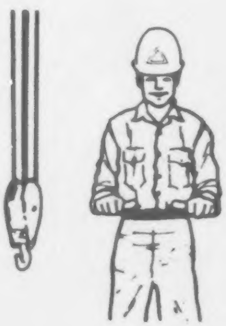


3. ______________

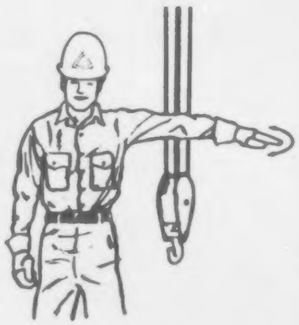
B. Emergency stop



1. ______________



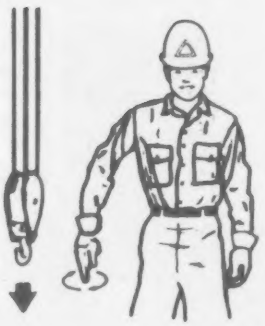
2. ______________

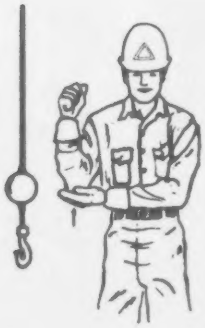


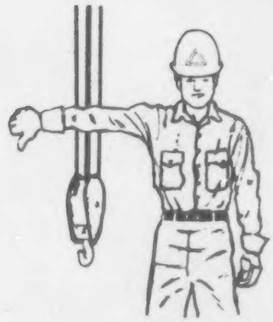
3. ______________

ASSIGNMENT SHEET #4

C. Lower boom

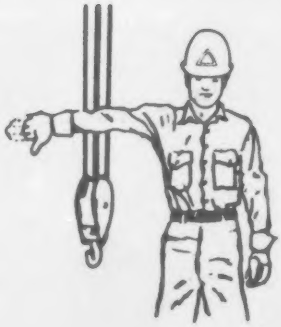


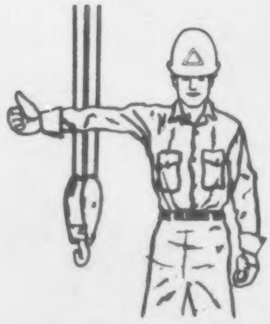


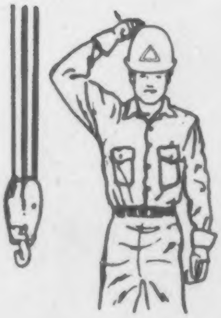


1. ______________ 2. ______________ 3. ______________

D. Lower boom and raise load



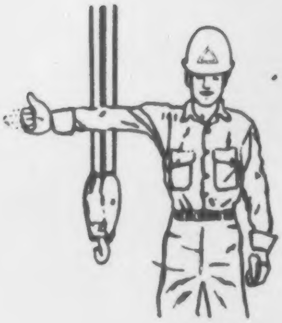


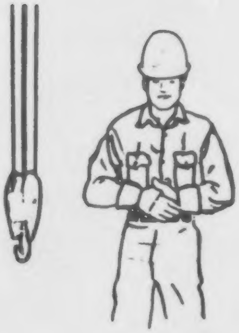


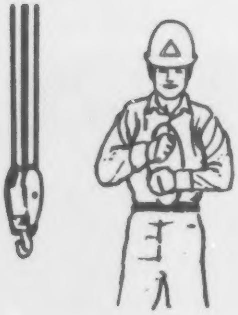
1. ______________ 2. ______________ 3. ______________

ASSIGNMENT SHEET #4

Dog everything

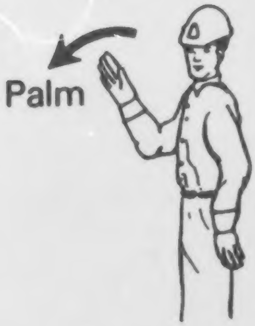


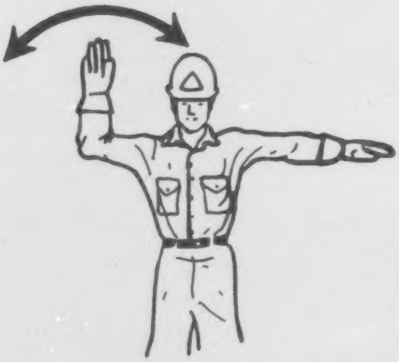


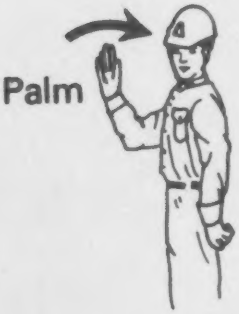


1. ______________ 2. ______________ 3. ______________

F. Turn while moving







1. ______________ 2. ______________ 3. ______________

ASSIGNMENT SHEET #4

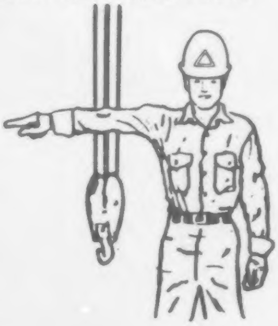
PART II

Write an "X" in the blank before the correct description of each illustration.

G. _____1. Turn while moving

_____2. Swing

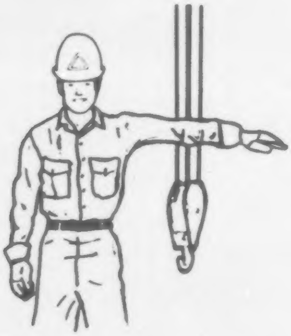
_____3. Move in this direction



H. _____1. Move in this direction

_____2. Stop

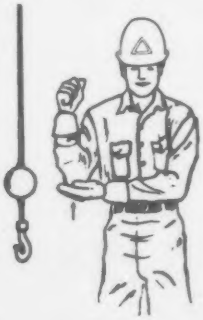
_____3. Raise boom



I. _____1. Emergency stop

_____2. Rehaul or retract

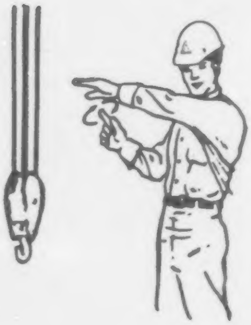
_____3. Use whipline



J. _____1. Lower boom and hold load

_____2. Lower boom and raise load

_____3. Move slowly

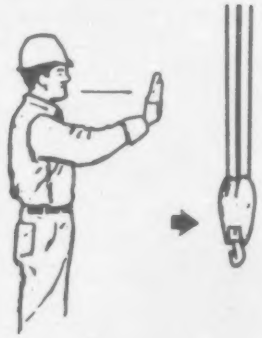


ASSIGNMENT SHEET #4

K. _____1. Lower load

_____2. Lower boom

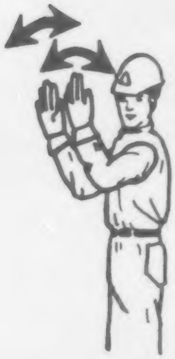
_____3. Travel



L. _____1. Stop

_____2. Straighten out

_____3. Turn while moving



RIGGING
UNIT XVIII

ASSIGNMENT SHEET #5--IDENTIFY BAD RIGGING PRACTICES

NAME ______________________________ SCORE ________________

Using the illustration below, write down as many bad rigging practices as you can find. Also list any safety tips that are not observed in the drawing.

A. ______________________

B. ______________________

C. ______________________

D. ______________________

E. ______________________

F. ______________________

G. ______________________

H. ______________________

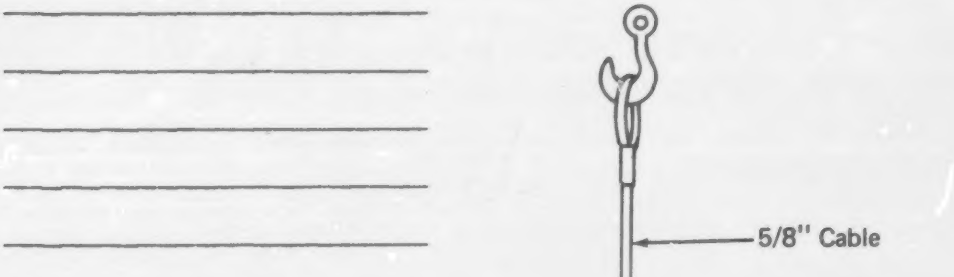
I. ______________________

J. ______________________

K. ______________________

L. ______________________

M. ______________________


5/8" Cable
3/8" Shackle
1/2" Cable
1/2" Hook eye
10 Tons

RIGGING
UNIT XVIII

ANSWERS TO ASSIGNMENT SHEETS

Assignment Sheet #1

PART I

A. 2
B. 3
C. 1
D. 2

PART II

E. 3
F. 2
G. 1
H. 2
I. 2
J. 3

Assignment Sheet #2

A. 4,800 pounds
B. 250 pounds
C. 1,460 pounds
D. 1,500 pounds
E. 270 pounds
F. 680 pounds

Assignment Sheet #3

A. 125 tons each sling
B. 18 1/2 tons each sling
C. 8 3/4 tons each sling
D. 1875 lbs each sling
E. 2 1/2 tons each sling

Assignment Sheet #4

PART I

A. 1
B. 3
C. 3
D. 1
E. 2
F. 2

PART II

G. 2
H. 2
I. 3
J. 3
K. 3
L. 2

ANSWERS TO ASSIGNMENT SHEETS

Assignment Sheet #5

A. Incorrect hand signals

B. Operator cannot see hand signals

C. Hand is on load

D. Person is under load

E. No tagline

F. Load is not balanced

G. No padding on sharp edges

H. No safety latch on hook block

I. Hook eyes too small and not in far enough

J. Sling angle too small

K. All sling cables too small

L. Shackles too small

M. No hard hat

RIGGING
UNIT XVIII

JOB SHEET #1--TIE KNOTS

I. Equipment

   A. Two pieces of equal-sized rope

   B. One piece of different-sized rope

   C. One piece of timber or pole

II. Procedure

   A. Square knot

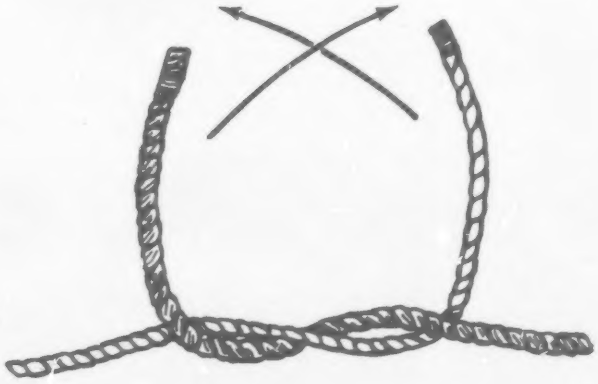
   (NOTE: When tying a square knot it is good to remember left-over-right and right-over-left.)

   1. Use two pieces of equal-sized rope

   2. Grasp one piece of rope in each hand about eight inches from end

   3. Cross left end over right end (Figure 44)

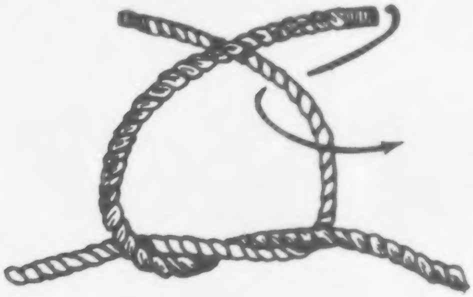
FIGURE 44



JOB SHEET #1

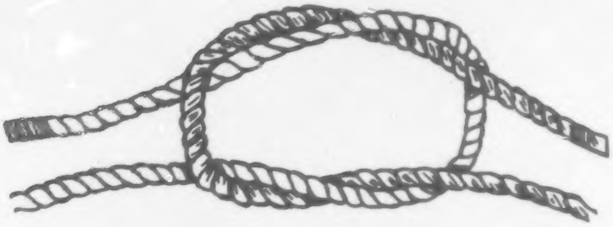
4. Cross right end over left end (Figure 45)

FIGURE 45



5. Pull the knot snug (Figure 46)

FIGURE 46

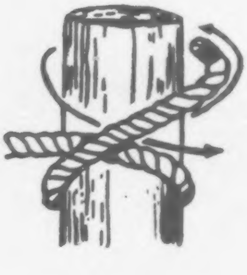


B. Clove hitch

1. Grasp one piece of rope and make one turn around a piece of timber

2. Cross the end over the standing part (Figure 47)

FIGURE 47

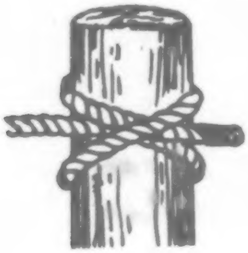


JOB SHEET #1

3. Take another turn around timber, and this time bring the end under the standing part

4. Pull the knot snug (Figure 48)

FIGURE 48

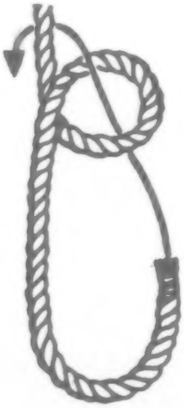


C. Bowline

1. Form an underhand loop several inches from end of rope

2. Pull rope end up through the loop from the back, leaving desired loop size (Figure 49)

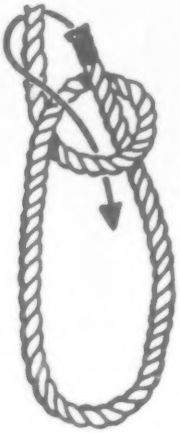
FIGURE 49



JOB SHEET #1

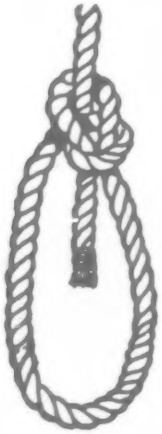
3. Twist rope end around the standing part and back through the loop (Figure 50)

FIGURE 50



4. Pull the knot snug (Figure 51)

FIGURE 51

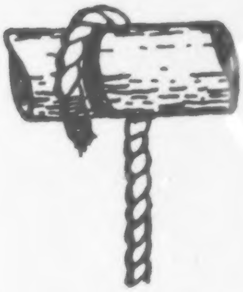


JOB SHEET #1

D. Half hitch

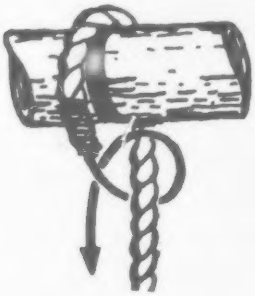
1. Make a turn over a piece of timber (Figure 52)

FIGURE 52



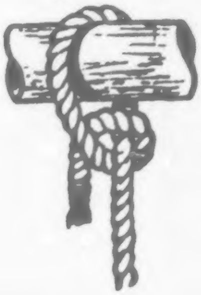
2. Make a turn around and over the standing part and back through the loop that was formed (Figure 53)

FIGURE 53



3. Pull knot snug (Figure 54)

FIGURE 54

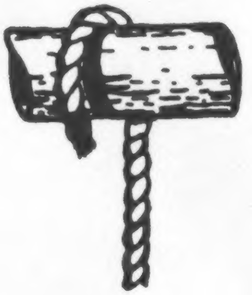


JOB SHEET #1

E. Two half hitches

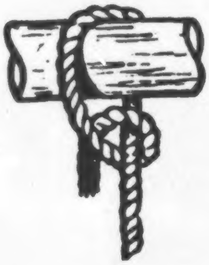
1. Make a turn over a piece of timber (Figure 55)

FIGURE 55



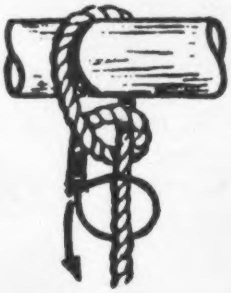
2. Make a turn around and over the standing part and back through the loop that was formed (Figure 56)

FIGURE 56



3. Make another turn around the standing part and back through the loop that was formed (Figure 57)

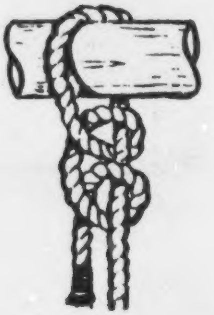
FIGURE 57



JOB SHEET #1

4. Pull knot snug (Figure 58)

FIGURE 58

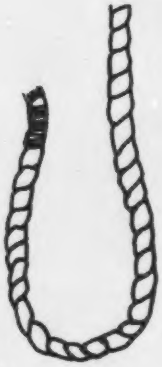


(NOTE: If the two hitches are slid together along the standing part to form a single knot, the knot becomes a clove hitch.)

F. Sheet bend

1. Form a loop on the end of one rope (Figure 59)

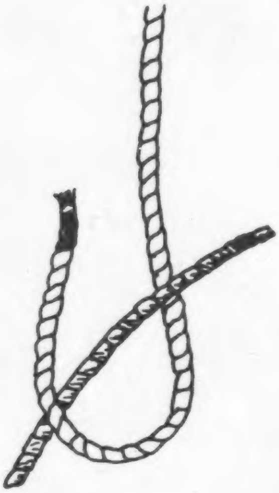
FIGURE 59



JOB SHEET #1

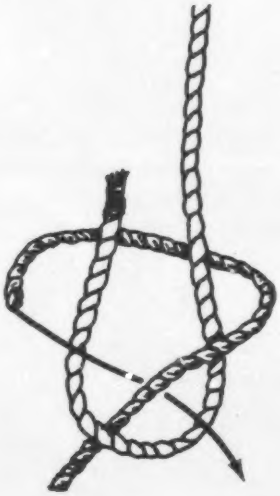
2. Lay second rope through the loop (Figure 60)

FIGURE 60



3. Twist end of second rope around standing part and running end of first rope (Figure 61)

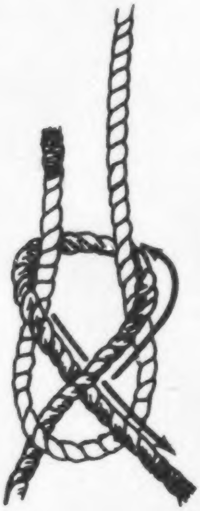
FIGURE 61



JOB SHEET #1

4. Continue bringing second rope around first rope; then run the end under standing part of itself and over first rope (Figure 62)

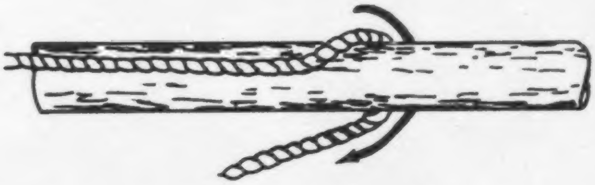
FIGURE 62



G. Timber hitch with half hitch

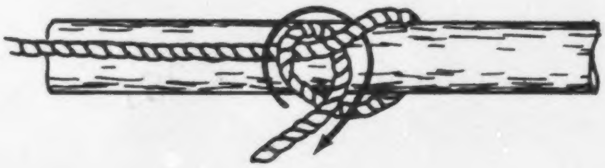
1. Lay rope lengthwise on timber; then make a turn over and around the piece of timber (Figure 63)

FIGURE 63



2. Place rope over and then under itself forming loop (Figure 64)

FIGURE 64



3. Wrap end back around itself two or three times (Figures 65 and 66)

FIGURE 65

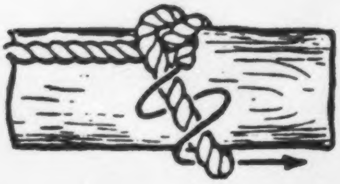
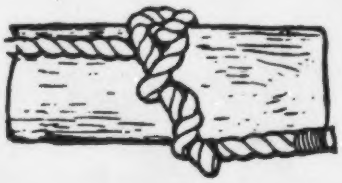


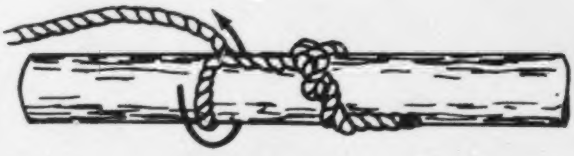
FIGURE 66



4. Pull rope so that it is snug

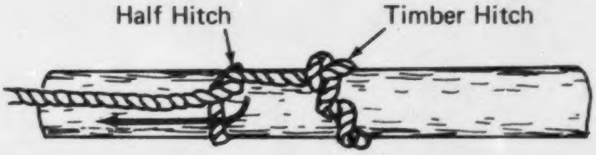
5. Pick up left end of rope, and make a loop under and around timber several inches from timber hitch (Figure 67)

FIGURE 67



6. Loop this end of rope under itself, and then pull snugly to the left (Figure 68)

FIGURE 68



RIGGING
UNIT XVIII

JOB SHEET #2--INSTALL WIRE ROPE CLIPS

I. Equipment

  A. Length of wire rope

  B. Three clips

  C. Thimble

  D. Wrench (to fit nuts on clips)

II. Procedure

  A. Turn back a length of rope beyond pointed end of thimble equal to the number of clips times clip spacing (Figures 69 and 70)

FIGURE 69

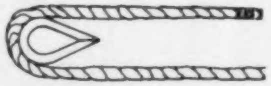
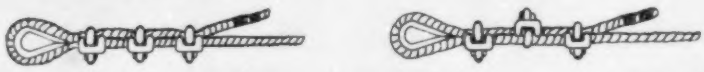


FIGURE 70



The Right Way to Clip Wire Rope

The Wrong Way to Clip Wire Rope

Number of Clips and Spacing for Safe Application

Rope Diam. in	Approx. Weight lb	Minimum No. Clips for Each Rope End	Spacing of Clips in
3/16	0.10	2	1 1/8
1/4	.19	2	1 1/2
5/16	.29	2	1 7/8
3/8	.47	2	2 1/4
7/16	.70	2	2 5/8
1/2	.78	3	3
5/8	1.06	3	3 3/4
3/4	1.59	4	4 1/2
7/8	2.40	4	5 1/4
1	2.72	4	6
1 1/8	3.20	5	6 3/4
1 1/4	4.50	5	7 1/2
1 3/8	4.60	6	8 1/4
1 1/2	5.80	6	9
1 5/8	7.20	6	9 3/4
1 3/4	9.50	7	10 1/2
2	12.50	8	12
2 1/4	15.50	8	13 1/2
2 1/2	18.00	8	15

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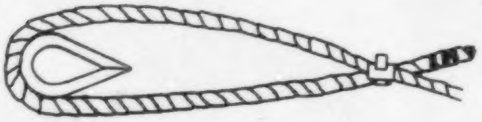
JOB SHEET #2

B. Position first clip at least one clip base width from end of wire rope (Figure 71)

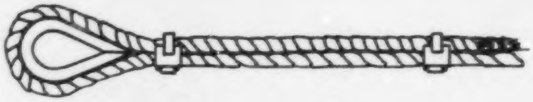
FIGURE 71



C. Tighten nuts, alternating from one to the other to obtain equal clamping action

D. Position second clip next to end of thimble and tighten nuts until firm but not tight (Figure 72)

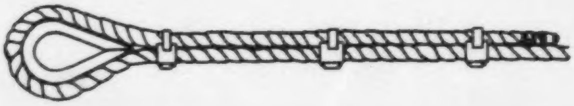
FIGURE 72



E. Space the third clip equally between the first two and tighten nuts until firm

F. Take up any rope slack; then alternately tighten nuts on each clip until they are tight (Figure 73)

FIGURE 73



RIGGING
UNIT XVIII

JOB SHEET #3--RIG AND HANDLE DIFFERENT TYPES OF LOADS

I. Equipment

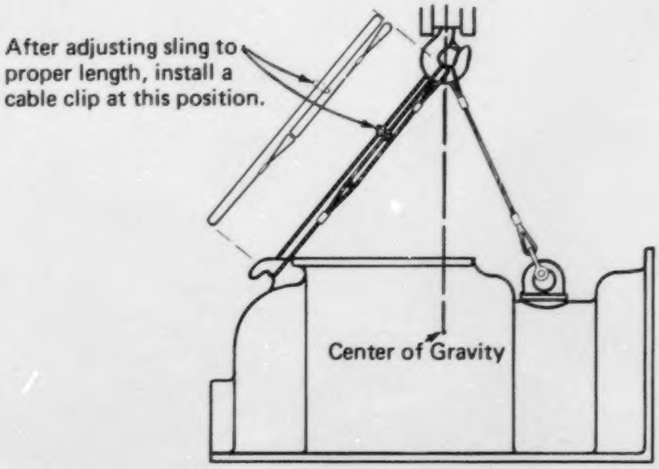
- A. Hoist
- B. Load
- C. Slings
- D. Spreader bar

II. Procedure for load where center of gravity is non-centered

(CAUTION: For loads that appear to be extremely heavy, the exact weight of load must be determined prior to rigging to assure that load will not exceed lifting capacity of hoist or exceed safe working load of wire rope used.)

- A. Estimate location of center of gravity
- B. Spot hook over this point
- C. Attach slings of proper strength and length from hook to lifting lugs (Figure 74)

FIGURE 74


After adjusting sling to proper length, install a cable clip at this position.
Center of Gravity

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(NOTE: Slings of different lengths will probably have to be used. Because they are not always available, it may be necessary to improvise.)

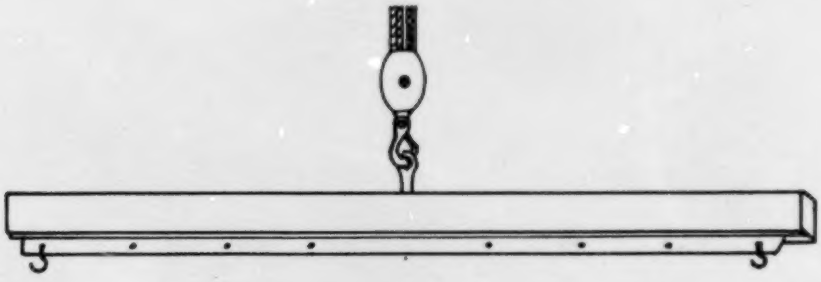
(CAUTION: Be very careful that proper slings are used and that they are attached properly. Use wire rope clips if necessary.)

JOB SHEET #3

III. Procedure for rigging extra long loads

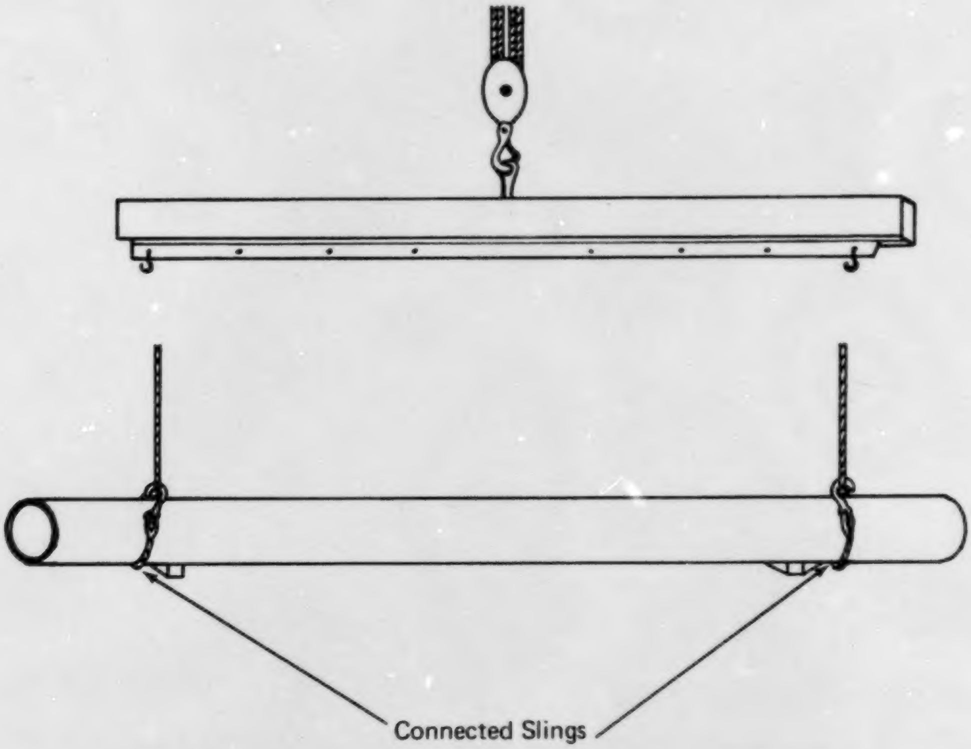
A. Attach spreader bar to hoist hook (Figure 75)

FIGURE 75



B. Center spreader bar over load; then connect sling to each end of load (Figure 76)

FIGURE 76

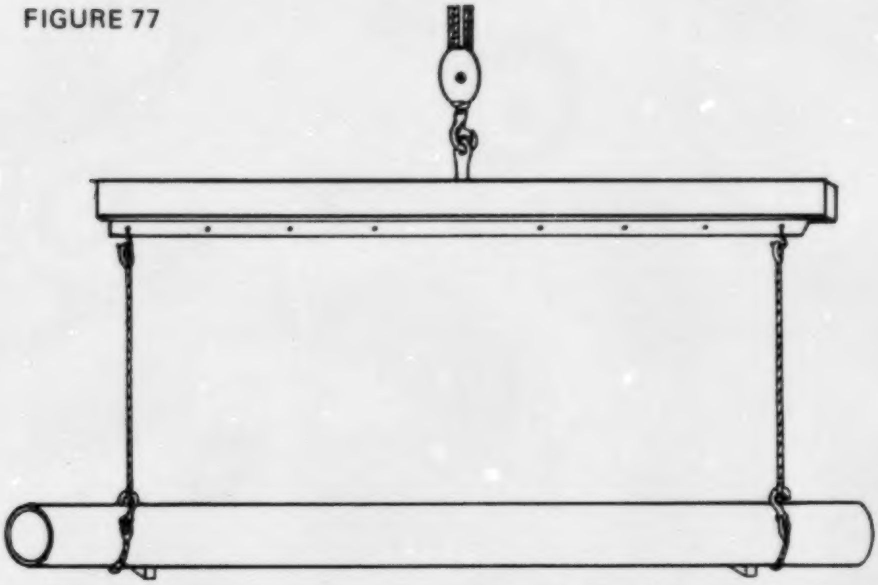


JOB SHEET #3

C. Connect long end of slings to spreader bar (Figure 77)

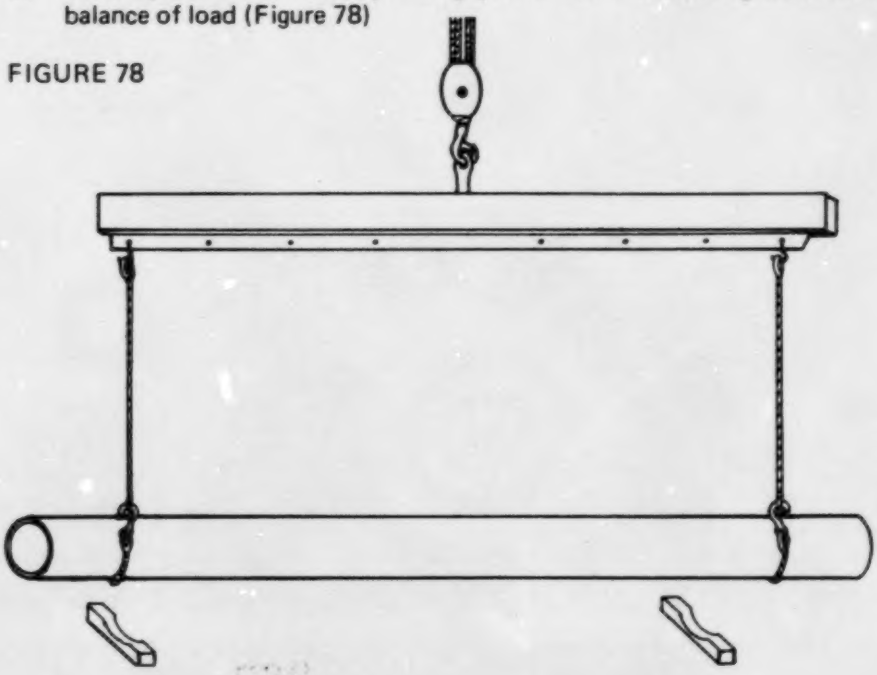
(NOTE: Be sure that hooks face out.)

FIGURE 77



D. Take up strain on line by lifting just a few inches off ground to check balance of load (Figure 78)

FIGURE 78



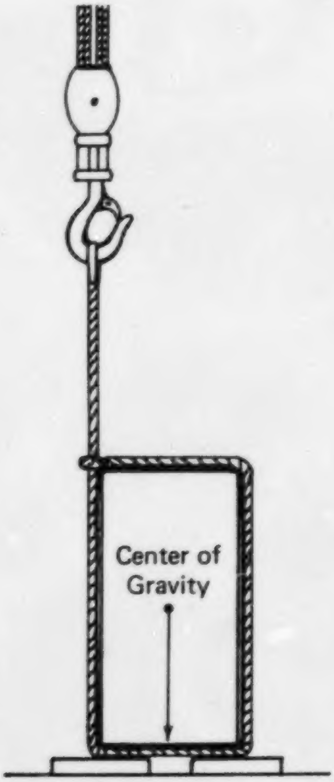
JOB SHEET #3

IV. Procedure for turning or rotating a load

A. Attach single sling so that the part of sling leading from hoist hook will go directly to bottom of load (Figure 79)

(NOTE: Be sure hook points away from hoist.)

FIGURE 79



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B. Attach sling to hook

JOB SHEET #3

C. Take strain on sling and move hook forward; this will cause load to tilt (Figure 80)

FIGURE 80

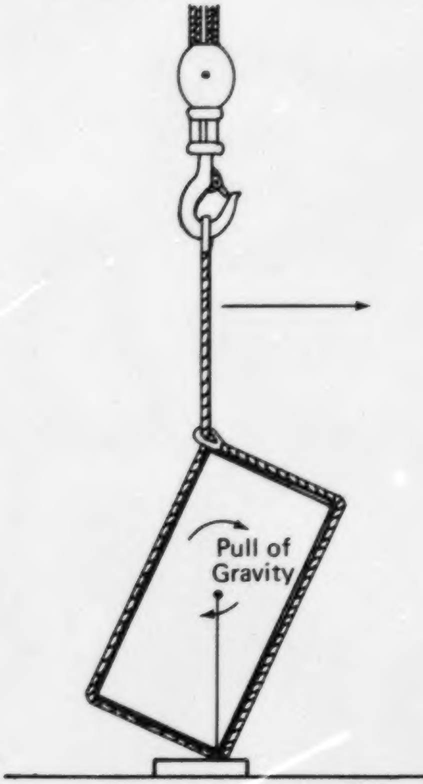
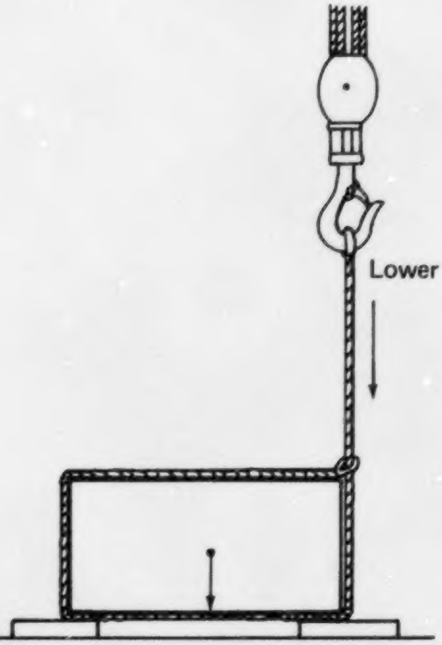


FIGURE 81



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D. Continue to move forward, lowering the hook; this will let the load slowly rotate to a flat position (Figure 81)

RIGGING
UNIT XVIII

TEST

NAME ________________________________ SCORE ______________

1. Match terms associated with rigging to their correct definitions. Write the correct numbers in the blanks.

_____a. Setting up block and tackle to a winch, stacking and hoisting material and equipment, and/or replacing cables on equipment

_____b. To attach a rope to a post, pole, ring, hook, or other object

_____c. Rope used to guide and/or steady load

_____d. Pulled from underneath the load

_____e. Pounds per square inch

_____f. Assembly of blocks and lines used to aid in lifting or pulling

_____g. Grooved wheel or pulley

_____h. Preliminary shaping of wires so that they will lie in place

_____i. Direction, length, or angle of twist of strands in a rope or cable

_____j. Pulley in a case which can be easily fastened to lines or objects by means of a hook, ring, or shackle

_____k. Material used in center of wire rope

_____l. Devices used to prevent crushing of load and to lift extra long or heavy loads

_____m. Point at which entire weight is concentrated

_____n. Metal loop which engages a hook

_____o. Grooved metal ring inserted in loop of rope to prevent wear

_____p. Slang meaning to deliberately slow down the work pace

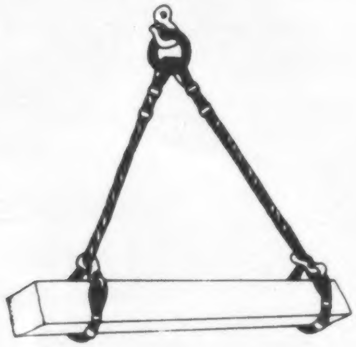
_____q. To join two parts of a rope or wire to form a continuous length

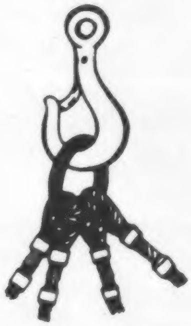
1. Lay
2. Eye
3. Sheave
4. Rigging
5. Thimble
6. Snatch block
7. psi
8. Preforming
9. Tagline
10. Dog
11. Tackle
12. Heaved
13. Splice
14. Core
15. Hitch
16. Center of gravity
17. Spreader bars

TEST

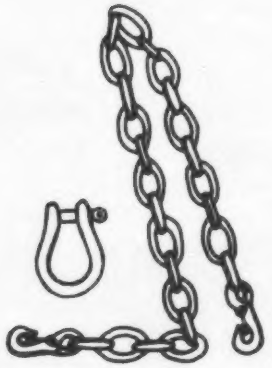
2. Identify the following accessories used for load lifting. Write the correct names in the blanks.

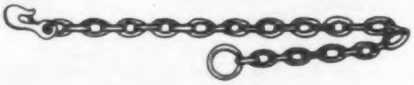
Bull chain
Bridles
Chokers (single slings)
Chain and shackle
Spreader bars
Grommet sling
Web sling



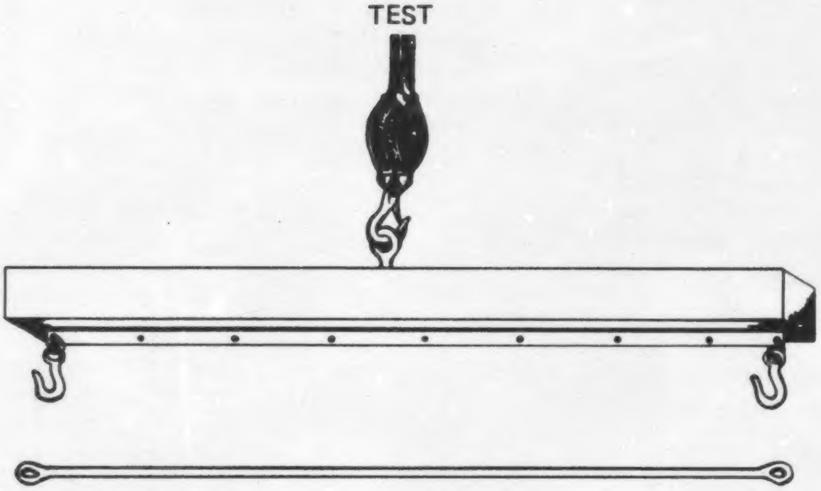


a. ______________________________

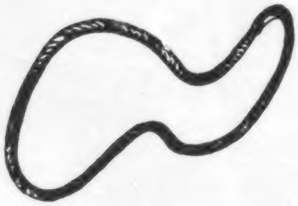


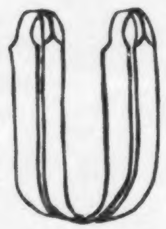


b. ______________________ c. ______________________

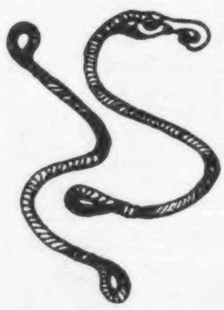


d. ______________________________





e. ____________________ f. ____________________

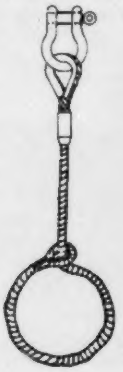


g. ____________________

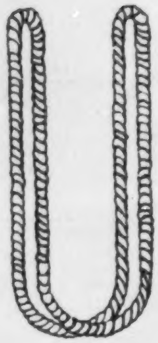
TEST

3. Identify the following hitches used to attach materials and equipment to hoist. Write the correct names in the blanks.

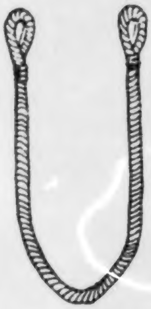
Choker hitch sling
Basket hitch sling
Choker hitch choker
Basket hitch choker
Inverted basket hitch sling



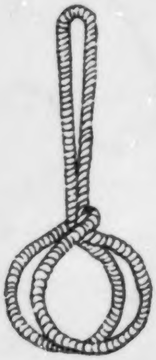
a. ______________________________



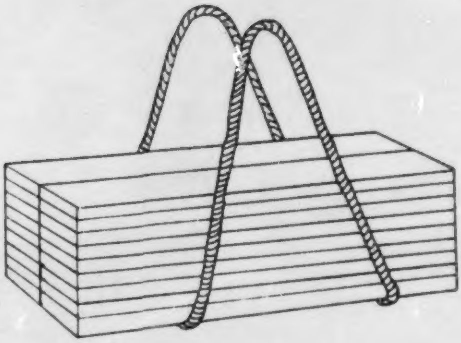
b. ______________________________



c. ______________________________



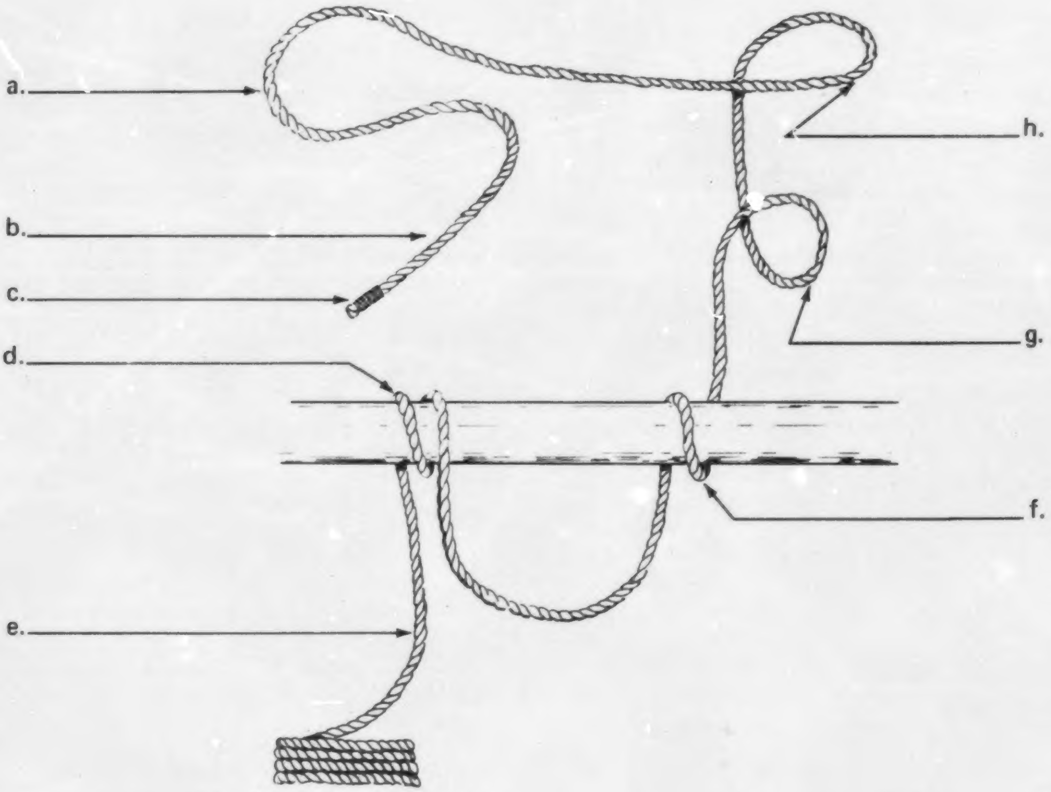
d. ______________________________



e. ______________________________

TEST

4. Label elements of knots, bends, and hitches. Write the correct names in the blanks.



5. Match types of knots to their correct uses. Write the correct numbers in the blanks.

_____a. Ties two lines of equal size together so that they will not slip

_____b. Forms a single loop that will not tighten or slip under strain

_____c. Fastens a line to timber or pipe

_____d. Ties line to timber or to a larger line

_____e. Holds timber securely when moving heavy timber or poles because of the pressure of one coil over other; the more tension applied, the tighter the hitch

1. Half hitch
2. Bowline
3. Clove hitch
4. Square knot
5. Timber hitch

TEST

______f. Fastens a line to a hook; generally used temporarily

______g. Forms a strong running loop which is convenient for running an eye; can also provide a choker-type sling at the end of a line

______h. Ties two lines of unequal size together; also used to tie a line to an eye

______i. Holds heavy timbers or poles for lifting or dragging

______j. Supports ends of scaffold plank and prevents it from tilting

______k. Secures the running end of a line to the standing part

6. Blackwall hitch
7. Timber hitch with half hitch
8. Running bowline
9. Scaffold hitch
10. Two half hitches
11. Sheet bend

6. State five safety tips related to rigging.

a. ____

b. ____

c. ____

d. ____

e. ____

7. Match types of materials used in construction of ropes to their characteristics. Write the correct numbers in the blank. Definitions are continued on the next page.

Natural fibers

______a. Strong and durable; used where dependability, ability to stand up under severe use, and weathering are required

______b. Less durable, lower in strength; used where requirements are less demanding and low cost is a major factor

Synthetic ropes

______a. Very strong, approximately twice the strength of manila; unusually high abrasion resistance, good resistance to weathering, and high degree of stretch

______b. Quite similar to nylon except somewhat lower in tensile strength and having much less stretch

1. Sisal
2. Nylon
3. Manila
4. Terylene
5. Polyethylene
6. Polypropylene

TEST

______c. Slightly less strength than nylon, but a degree of stretch similar to terylene; very light, actually floats on water, and is resistant to rot

______d. Has about same strength as polypropylene, but has a high stretch factor and excellent resistance to mildew, decay, acids, and alkalies

8. Describe general construction of rope.

9. State six precautions to observe when caring for ropes.

a. ______

b. ______

c. ______

d. ______

e. ______

f. ______

TEST

10. Determine tensile strength of various kinds and sizes of the following new ropes. Use the chart shown below.

Diameter	Manila	Nylon	Dacron	Poly-ethylene	Poly-propylene
3/16"	450	960	720	700	740
1/4"	600	1,500	1,150	1,200	1,250
5/16"	1,000	2,400	1,750	1,750	1,900
3/8"	1,350	3,400	2,450	2,500	2,700
7/16"	1,750	4,800	3,400	3,400	3,550
1/2"	2,650	6,200	4,400	4,100	4,500
9/16"	3,450	8,000	5,700	5,100	5,400
5/8"	4,400	10,000	7,300	6,000	6,600
3/4"	5,400	14,000	10,000	7,500	8,000
7/8"	7,700	19,000	13,600	9,900	10,750
1"	9,000	24,000	16,500	11,000	12,500
1 1/8"	12,000	31,500	21,600	15,000	17,000
1 1/4"	13,500	36,000	24,400	17,300	19,500

a. 1/4-inch manila--Tensile strength = ______________________________

b. 1/4-inch polyethylene--Tensile strength = ______________________________

c. 1 1/4-inch nylon--Tensile strength = ______________________________

d. 3/4-inch polypropylene--Tensile strength = ______________________________

e. 3/8-inch dacron--Tensile strength = ______________________________

11. State the importance of spreading sling angles.

a. ______________________________

b. ______________________________

c. ______________________________

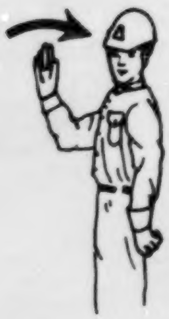
d. ______________________________

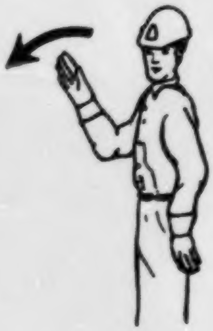
e. ______________________________

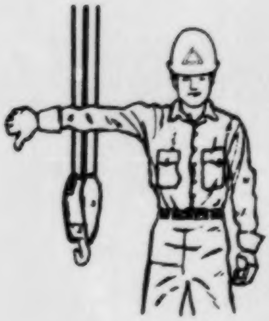
TEST

12. Distinguish among hand signals used in rigging operations. Write an "X" in the blank under each correct illustration.

a. Lower boom

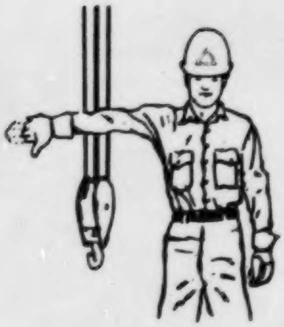


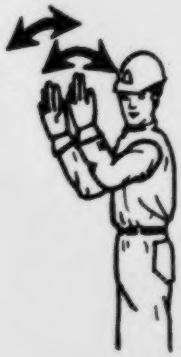


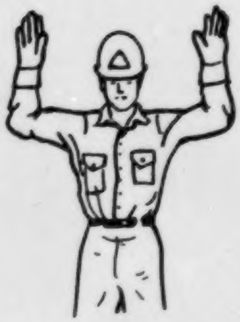


1) ____________ 2) ____________ 3) ____________

b. Straighten out



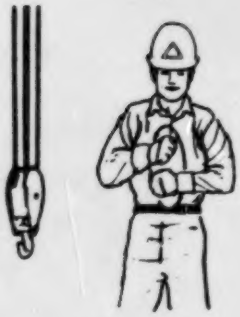


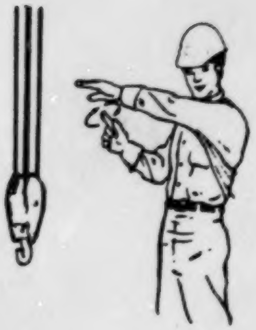


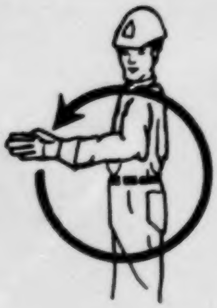
1) ____________ 2) ____________ 3) ____________

TEST

c. Move vehicle

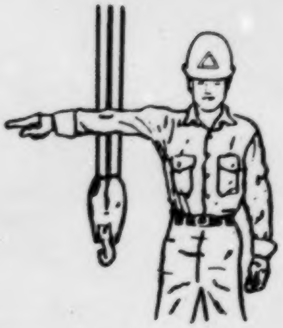


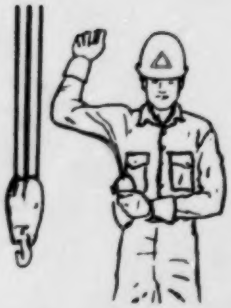


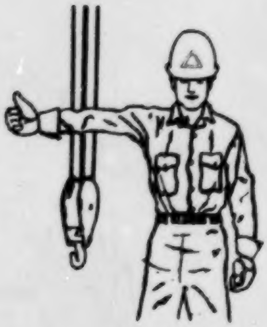


1) ____________ 2) ____________ 3) ____________

d. Swing



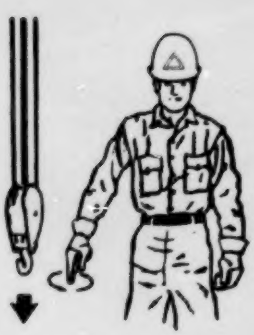




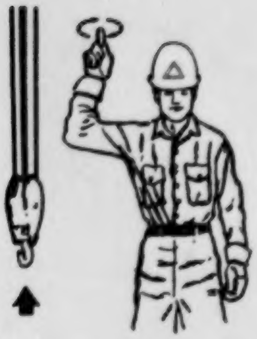
1) ____________ 2) ____________ 3) ____________

TEST

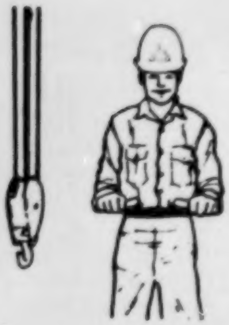
e. Retract boom



1) ____________

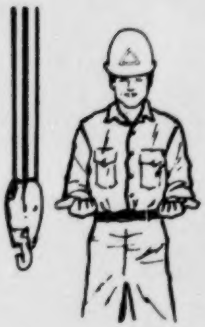


2) ____________

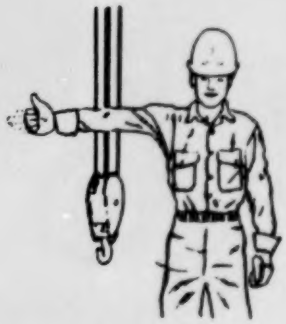


3) ____________

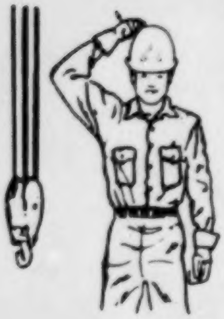
f. Raise the boom and lower the load



1) ____________



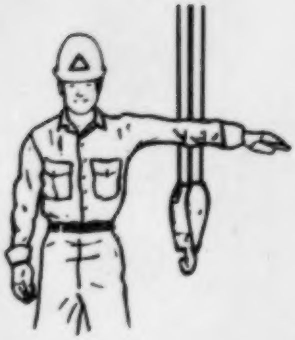
2) ____________

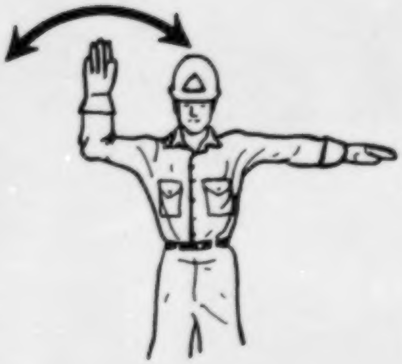


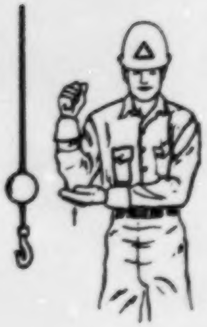
3) ____________

TEST

g. Turn while moving

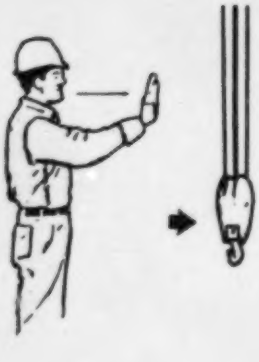


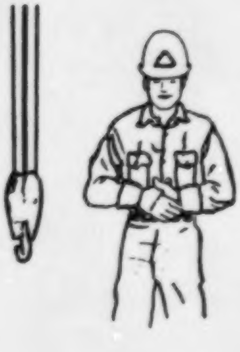


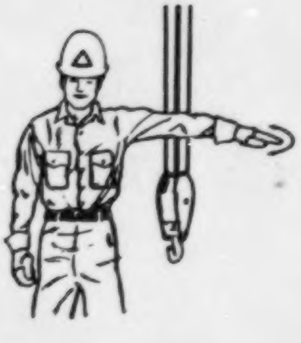


1) ______________ 2) ________________ 3) ________________

h. Emergency stop







1) ______________ 2) ________________ 3) ________________

TEST

13. Select from the following list construction characteristics of wire rope used in rigging. Write an "X" in the blank before each correct answer.

_____a. Where rope lies

_____b. Grade of steel wire used

_____c. Number of turns around drum

_____d. Preformed lay

_____e. Size of wire in strand

_____f. Number of wires in each strand

_____g. Type of core

_____h. Length of cable

_____i. Name of cable

_____j. Size of core

14. Match strengths of steel used in wire rope to their grades. Write the correct numbers in the blanks.

_____a. Mild plow steel

_____b. Improved plow steel

_____c. Iron wire

_____d. Traction steel

_____e. Plow steel

1. 200,000 to 220,000 psi
2. 240,000 to 260,000 psi
3. 180,000 to 190,000 psi
4. 100,000 psi
5. 220,000 to 240,000 psi

15. Arrange in order steps to take when performing maintenance on wire rope. Write a "1" before the first step, a "2" before the second step, and so on.

_____a. Apply oil by moving rope through a long pan

_____b. Let cool and thicken

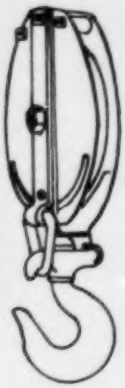
_____c. Heat oil that is recommended by manufacturer

_____d. Wipe off surplus oil as rope leaves pan

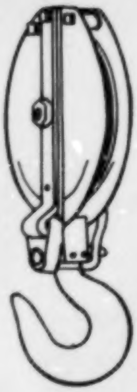
_____e. Check for frayed and/or worn wires

TEST

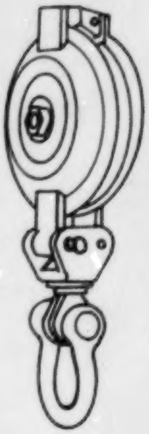
16. Label types of snatch blocks. Write the correct name in the blank under each illustration.



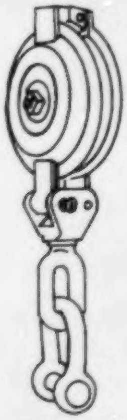
a. ______________________



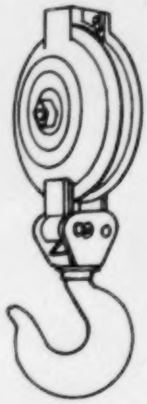
b. ______________________



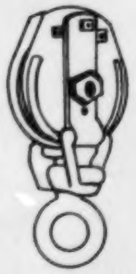
c. ______________________



d. ______________________



e. ______________________



f. ______________________

17. Select from the following list types of cable fittings. Write an "X" in the blank before each correct answer.

_____a. Drop forged steel swivel hook and socket

_____b. Midget turn buckle

_____c. Closed socket with chain

_____d. Closed socket for flat rope

_____e. Jaw and eye turnbuckle

_____f. Eye bolt with nut

TEST

______g. Swaged clevis fitting

______h. Rope binding hook

______i. Standard shackle

______j. S-hook

______k. Turnbuckle with spliced rope

______l. Tie-out chain

______m. Drop forged steel hook with eye

______n. Safety snap hook

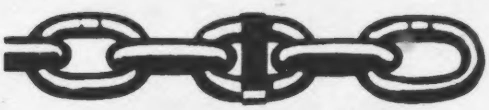
______o. Lock-link wire chain

______p. Drop forged steel hook with shank

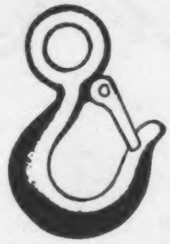
______q. Screw pin shackle

18. Identify the following types of towing chains and accessories. Write the correct names in the blanks.

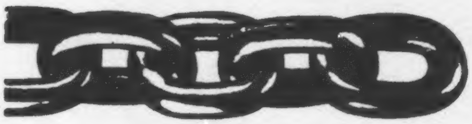
Shackles
Proof chain
Alloy chain
Swivels
Slip hook
BBB chain
Grab hook
Rings
High test chain
Safety hook



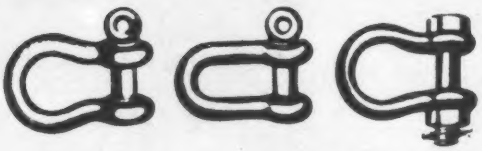
a. ______________________________



b. ______________________________

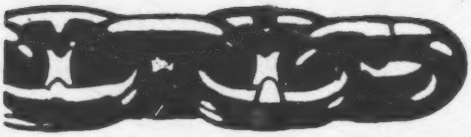


c. ______________________________

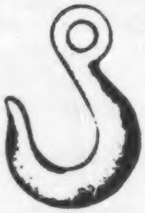


d. ______________________________

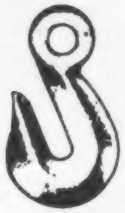
TEST



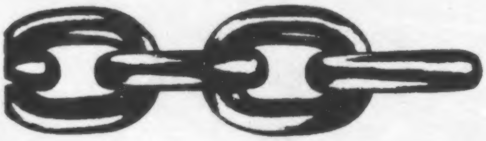
e. ______________________________



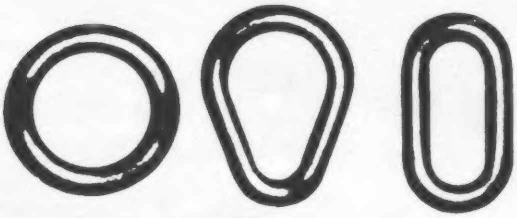
f. ______________________________



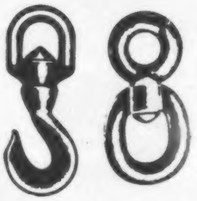
g. ______________________________



h. ______________________________



i. ______________________________



j. ______________________________

19. Select from the following list good rigging practices. Write an "X" in the blank before each correct answer.

______a. Pad all sharp corners and edges

______b. Use tagline to pull loads

______c. Wrap rope around hook when not in use

______d. Center crane over load before lifting

______e. Give all hand signals clearly and correctly

______f. Secure all unused sling lines

______g. Turn hooks to face hoist

TEST

_____h. Never allow a shackle to be pulled at an angle

_____i. Unhook load as soon as it is low enough to reach

_____j. Use a shackle whenever two or more ropes are to be used over a hook

(NOTE : Questions 20 through 25 list the assignment and job sheets. They are an important part of this test. If they have not been completed, check with your instructor.)

20. Distinguish among types of knots.

21. Calculate safe working load (SWL) of different types and sizes of ropes.

22. Calculate sling stress.

23. Distinguish among hand signals used in rigging operations.

24. Identify bad rigging practices.

25. Demonstrate the ability to

    a. Tie knots.

    b. Install wire rope clips.

    c. Rig and handle different types of loads.

RIGGING
UNIT XVIII

ANSWERS TO TEST

1. a. 4
   b. 15
   c. 9
   d. 12
   e. 7
   f. 11
   g. 3
   h. 8
   i. 1
   j. 6
   k. 14
   l. 17
   m. 16
   n. 2
   o. 5
   p. 10
   q. 13

2. a. Bridles
   b. Chain and shackle
   c. Bull chain
   d. Spreader bars
   e. Grommet sling
   f. Web sling
   g. Chokers (single slings)

3. a. Choker hitch choker
   b. Basket hitch sling
   c. Basket hitch choker
   d. Choker hitch sling
   e. Inverted basket hitch sling

4. a. Bight
   b. Running end
   c. Whipping
   d. Round turn

ANSWERS TO TEST

e. Standing part

f. Turn

g. Underhand loop

h. Overhand loop

5. a. 4

b. 2

c. 3

d. 1

e. 5

f. 6

g. 8

h. 11

i. 7

j. 9

k. 10

6. Answer should include any five of the following

a. Use personal protective devices such as goggles, gloves, safety shoes, and hard hats

b. Use tagline to guide and/or steady load

c. Do not walk under load

d. Be sure load is balanced properly

e. Do not overload equipment

f. Stand clear when slings are heaved from under loads

g. Be sure outriggers and/or stabilizers are in use and are on solid footing

h. Be extra cautious around power lines

i. Use corner saddles, padding, or wood blocking to protect slings from sharp bends and sharp edges

j. Lubricate slings to prevent rust

k. Be sure all hooks have safety snaps

l. Be sure there are enough people to hold tagline for heavy loads

ANSWERS TO TEST

7. Natural fibers	Synthetic Ropes	
a. 3	a. 2	c. 6
b. 1	b. 4	d. 5

8. a. Rope is normally made of three strands, each of which is made of several threads
   b. The rope itself is twisted in a right-hand direction while each strand is twisted in a left-hand direction and the individual threads are twisted in a right-hand direction
   c. Reversal of twist in strands gives the rope a balance or set which eliminates the tendency to unwind

9. Answer should include any six of the following
   a. When taking rope from a coil, always remove it from the center in a counter-clockwise direction
   b. When rope is not in use, it should be re-coiled in a clockwise direction
   c. When rope is attached to a hook, ring, or pulley block, a thimble should be placed in the loop or eye to reduce wear and to decrease stress
   d. Protect rope from moisture and weather as much as possible
   e. Do not disturb a frozen rope until completely thawed
   f. Keep rope away from acids, other chemicals, and heat
   g. Do not drag rope over ground or sharp edges
   h. If possible, do not make abrupt bends in rope
   i. Wash and dry dirty rope before storing it
   j. Store rope so that air may circulate around it
   k. If manila rope becomes stiff and hard because of being wet, treat with a thin lubricating oil or warm petrolatum

10. a. 600 pounds
    b. 1,200 pounds
    c. 36,000 pounds
    d. 8,000 pounds
    e. 2,450 pounds

ANSWERS TO TEST

11. a. Changing angle of sling leg may increase the stress on the sling
    b. As angle is reduced, lifting capacity is reduced very rapidly
    c. When single leg of sling is at 60° angle, lifting capacity is only 87 percent of a vertical leg
    d. When single leg of sling is at 45° angle, lifting capacity is only 71 percent of a vertical leg
    e. When single leg of sling is at 30° angle, lifting capacity is only 50 percent of a vertical leg

12. a. 3
    b. 2
    c. 3
    d. 1
    e. 3
    f. 2
    g. 2
    h. 3

13. b, d, e, f, g

14. a. 1
    b. 2
    c. 4
    d. 3
    e. 5

15. a. 3
    b. 5
    c. 2
    d. 4
    e. 1

16. a. Drop link
    b. Self locking
    c. Swivel shackle
    d. Upset swivel shackle
    e. Swivel hook
    f. Swivel eye

ANSWERS TO TEST

17. a, c, d, g, i, k, m, n, p, q

18. a. High test chain
    b. Safety hook
    c. BBB chain
    d. Shackles
    e. Alloy chain
    f. Slip hook
    g. Grab hook
    h. Proof chain
    i. Rings
    j. Swivels

19. a, d, e, f, h, j

20. Evaluated to the satisfaction of the instructor

21. Evaluated to the satisfaction of the instructor

22. Evaluated to the satisfaction of the instructor

23. Evaluated to the satisfaction of the instructor

24. Evaluated to the satisfaction of the instructor

25. Performance skills evaluated to the satisfaction of the instructor